SPIRALS FOR STREET RAILWAY CURVES

Frog and Switch Dept.

December 17, 1907.

President, Pennsylvania Steel Co.,

Steelton, Pennsylvania.

Dear Sir:-

Will you kindly favor this library, for the use of our engineering students, with a copy of the pamphlet published in 1906 by your company entitled "Spirals for Street Railway Curves, Formulas and Tables."?

Yours very truly,

H&R

Librarian.

SPIRALS

for

Street Railway Curves and Easement Curves

for

Street Railway Branch-Offs

Complete Formulas and Tables

The Pennsylvania Steel Company

Steelton, Pa.

FROG AND SWITCH DEPARTMENT

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of

The Pennsylvania Steel Company

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THE Spiral System presented in the following pages has been in use by The Pennsylvania Steel Company for the last decade, and has given general satisfaction. It consists of a transition formed of arcs of diminishing radii, and is calculated upon the center line of track, since that is substantially the path followed by the center of gravity of the cars. The purpose of a spiral ending on a short radius street railway curve is not as in steam railroad practice, to enable the super-elevation of the outer rail of curve to be gradually attained, but to reduce the shock due to the change in direction of the car. The switch easements are so designed that a plain curve can be converted

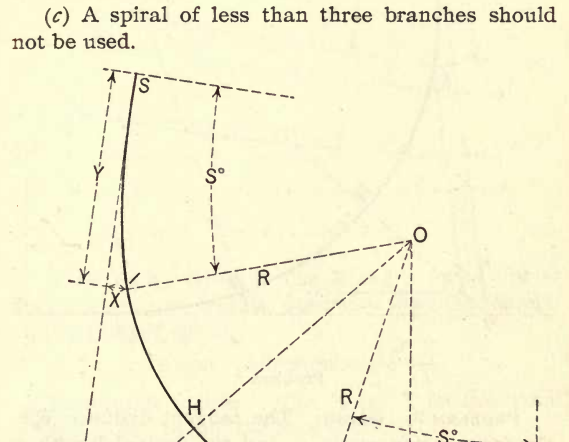
into a branch-off with the minimum disturbance of existing work while retaining standard switches and mates, and some simplification of computation is also obtained. The solutions of the various problems given present sufficient information to enable any data required for the laying out or construction of track to be readily secured.

PROBLEM 1. To select a spiral.

(*a*) The radius of the main curve must be less than the preceding branch of the spiral, must be more than the next branch would be were it produced, and should nearly equal the latter.

(*b*) The longer the spiral, the easier the entrance will be. But bear in mind that the main body of the curve should be circular, the spiral simply acting as an entrance to it.

(*c*) A spiral of less than three branches should not be used.

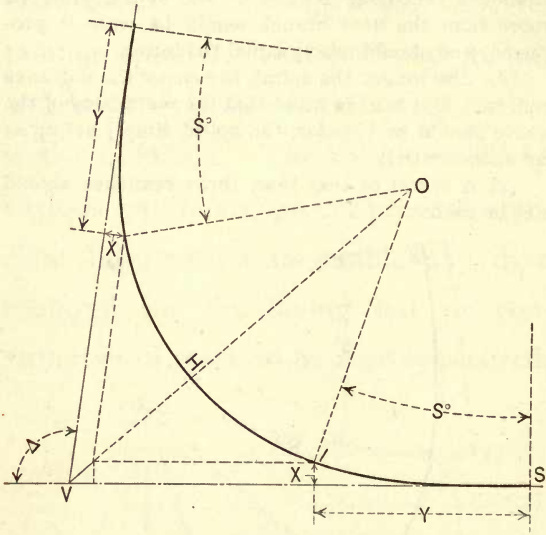


Problem 2

PROBLEM 2. Given: A circular curve with symmetrical spirals, to find the tangent and external distances.

O G=R+X—versine S° R;
G S=Y—sine S° R;

Tangent distance=O G tan ½ Δ+G S;
External distance=O G ex sec ½ Δ+X—versine S° R.



Problem 3

PROBLEM 3. Given: The tangent distance V S, the intersection angle Δ, and the desired length of spiral, to find the radius of the curve. Approximate R=cotangent ½ Δ(V S—½ length of spiral). Having selected a spiral by this radius, the exact radius may be found, if required, by the following formula:

$$R=\frac{\cos \frac{1}{2}\Delta(V\,S-Y-X\tan\frac{1}{2}\Delta)}{\text{sine}\,(\frac{1}{2}\Delta-S)}.$$

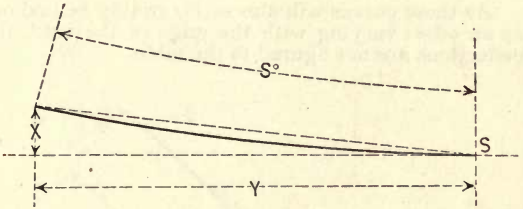
Caution—If the result is enough different from the original radius to require a change in the spiral by Problem 1, a second trial must be made.

PROBLEM 4. Given: The intersection angle Δ

and the external distance V H, to find the radius. Approximate to the radius by finding that for a simple curve passing through the point H, and select a spiral for a radius somewhat smaller.

$$\text{Then } R=\frac{V\,H\cos \tfrac{1}{2}\Delta - X}{\cos S^\circ - \cos \tfrac{1}{2}\Delta} \text{ (Searle).}$$

Caution—If the result is enough different from the original radius to require a change in the spiral by Problem 1, a second trial must be made.



Problems 5 and 6

PROBLEM 5. Given: The X and Y for any point on the spiral; to find the deflection from the tangent at the point of spiral.

$$\text{Tangent deflection angle}=\frac{X}{Y}.$$

PROBLEM 6. Given: The X and Y for any point on the spiral, to find the long chord.

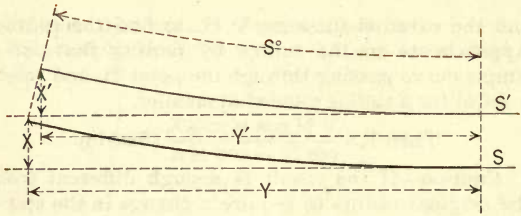
$$(a)\ \text{Long chord}=\frac{Y}{\text{cosine def angle}},$$

$$\text{or } (b)\ \text{Long chord}=\sqrt{X^2+Y^2}.$$

PROBLEM 7. Given: X and Y for a point on the spiral, to find X′ and Y′ on a line parallel to the spiral, and offset the distance S S′ inside the spiral.

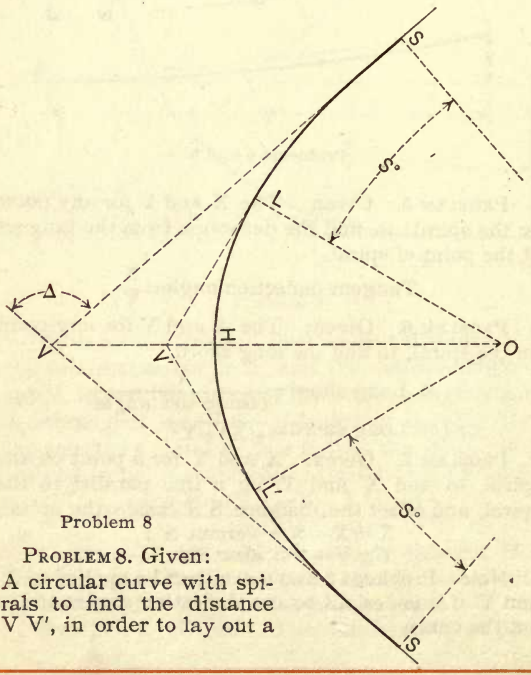
$$X'=X-S\,S' \text{ versine } S^\circ;$$
$$Y'=Y-S\,S' \text{ sine } S^\circ.$$

Note—Problems 5 and 6 can then be applied to X′ and Y′ if it is desired to use deflection angles to lay out the curve.



Problem 7

As these curves will almost invariably be laid out on an offset varying with the gage of the road, the deflections are not figured in the table.



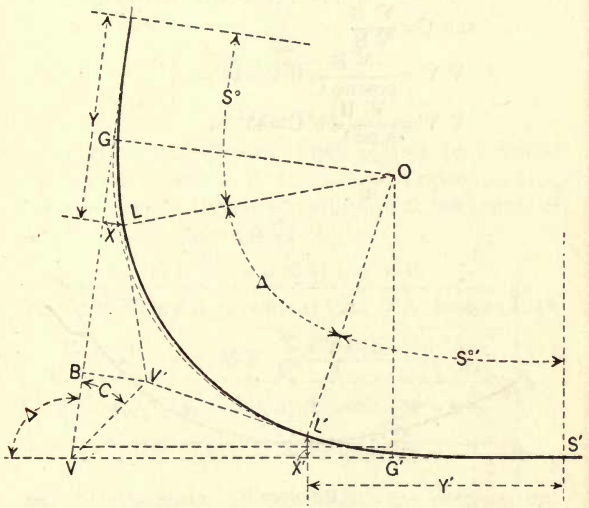
Problem 8

PROBLEM 8. Given:

A circular curve with spirals to find the distance V V', in order to lay out a

tangent to the circular curve, from which the latter may be laid out in the usual manner.

V H=see Problem 2;
V′ H=R ex secant (½ Δ —S);
V V′=V H—V′ H.



Problem 9

PROBLEM 9. General solution for unsymmetrical curves.

O G=R+X—R versine S°;
G S=Y—R sine S°;
O G′=R+X′—R versine S°′;
G S′=Y—R sine S°′;

$$V\,S=\tan \tfrac{1}{2}\Delta\, O\,G+G\,S+\frac{O\,G'-O\,G}{\text{sine }\Delta};$$

$$V\,S'=\tan \tfrac{1}{2}\Delta\, O\,G+G'\,S'\pm\frac{O\,G'-O\,G}{\tan \Delta}.$$

Note — ± in above; + if △ is more than 90°, and — if △ is less than 90°.

$$\triangle' = \triangle - (S° + S°');$$

V′ L or V′ L′ = tan ½ △′ R;

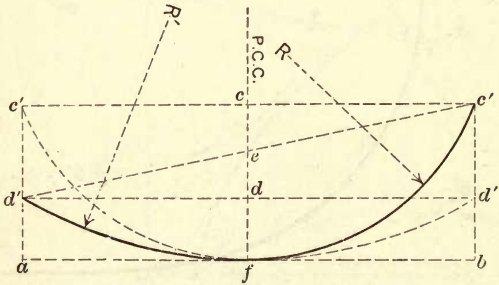
V′ B = X + V′ L sine S°;

V B = V S − (Y + V′ L − V′ L versine S°);

$$\tan C = \frac{V' B}{V B}$$

$$V V' = \frac{V B}{\text{cosine } C} \text{ if } C = 45° -;$$

$$V V' = \frac{V' B}{\text{sine } C} \text{ if } C = 45° +.$$

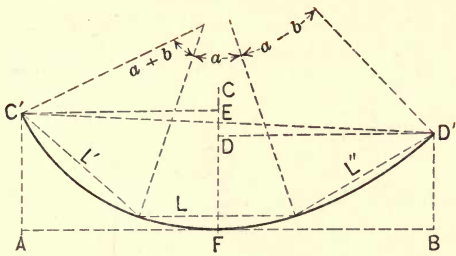


Problem 10

PROBLEM 10. Given: The middle ordinate for a chord of length a b for R and R′, to find the middle ordinate at the P C C. From the figure it is evident that d′ c′ bisects c d.

$$\therefore e f = \frac{c f + d f}{2}.$$

Therefore, the middle ordinate at any P C C in the spiral equals one-half the sum of the middle ordinates for the radii on each side for the same chord.



Problem 11

PROBLEM 11. Given: That portion of a spiral with equal chords L, L′ and L″ and angles $a-b$, a, and $a+b$, to find the middle ordinate at the center of the chord L in the length D′ C′.

$$C\,F=C'\,A \text{ and } D\,F=D'\,B.$$

From the figure it is evident that D′ C′ bisects C D.

$$\therefore E\,F=\frac{C\,F+D\,F}{2}.$$

Then $C'\,A=\frac{1}{2}\,L \tan \frac{1}{4}a+L' \sin \left(\frac{1}{2}\,a+\frac{a+b}{2}\right)$;

$$D'\,B=\frac{1}{2}\,L \tan \frac{1}{4}a+L'' \sin \left(\frac{1}{2}\,a+\frac{a-b}{2}\right);$$

and since the sines of small angles are proportional to the angles,

$$\frac{C\,F+D\,F}{2}=E\,F=\frac{1}{2}\,L \tan \frac{1}{4}\,a+L \sin a.$$

But this last equation equals the middle ordinate in the length A B for the radius of the central arc; and since the increment to the angle b would be equal if L′ and L″ were equal, the middle ordinate at the center of any arc of the spiral, for any length of chord, is equal to the middle ordinate of the radius of that arc in the same length.

Standard Spirals.

The Pennsylvania Steel Co.

Center Line Data.

SPIRAL No. 2

Rad.	Angle	X	Y	S°	Versine	Sine
300	0°–30′	0.011	2.618	0°–30′	.00004	.00873
150	1°–00′	0.057	5.235	1°–30′	.00034	.02618
100	1°–30′	0.160	7.851	3°–00′	.00137	.05234
75	2°–00′	0.342	10.463	5°–00′	.00381	.08716
60	2°–30′	0.627	13.065	7°–30′	.00856	.13053
50	3°–00′	1.036	15.651	10°–30′	.01675	.18224
42½	3°–30′	1.587	18.187	14°–00′	.02970	.24192
37½	4°–00′	2.309	20.703	18°–00′	.04894	.30902

SWITCH EASEMENT S 2–75

Rad.	Angle	X	Y	S°
75	7°–50′	0.700	10.222	7°–50′
45⅓	2°–40′	1.036	12.305	10°–30′
42½	3°–30′	1.587	14.841	14°–00′
37½	4°–00′	2.309	17.357	18°–00′

This Easement gives an O G equal to and a G S 3.346 less than Spiral No. 2.

SPIRAL No. 2½

Rad.	Angle	X	Y	S°	Versine	Sine
444	0°–20′	0.007	2.583	0°–20′	.00002	.00582
222	0°–40′	0.038	5.166	1°–00′	00015	.01745
148	1°–00′	0.105	7.748	2°–00′	.00061	.03490
111	1°–20′	0.226	10.328	3°–20′	.00169	.05814
89	1°–40′	0.414	12.910	5°–00′	00381	.08716
74	2°–00′	0.684	15.478	7°–00′	.00745	.12187
63½	2°–20′	1.051	18.038	9°–20′	.01324	.16218
55½	2°–40′	1.529	20.576	12°–00′	.02185	.20791
49	3°–00′	2.128	23.070	15°–00′	.03407	.25882
44½	3°–20′	2.870	25.550	18°–20′	.05076	.31454
40½	3°–40′	3.763	27.983	22°–00′	.07282	.37461

SWITCH EASEMENT S 2½–100

Rad.	Angle	X	Y	S°
102⅓	6°–30′	0.658	11.584	6°–30′
56½	5°–30′	1.529	16.936	12°–00′
49	3°–00′	2.128	19.430	15°–00′
44½	3°–20′	2.870	21.910	18°–20′
40½	3°–40′	3.763	24.343	22°–00′

This Easement gives an O G equal to and a G S 3.640 less than Spiral No. 2½.

SWITCH EASEMENT S 2½–200

Rad.	Angle	X	Y	S°
200	4°–00′	0.487	13.951	4°–00′
129	1°–00′	0.664	16.196	5°–00′
74	2°–00′	0.934	18.764	7°–00′
63½	2°–20′	1.301	21.324	9°–20′
55½	2°–40′	1.779	23.862	12°–00′
49	3°–00′	2.378	26.356	15°–00′
44½	3°–20′	3.120	28.836	18°–20′
40½	3°–40′	4.013	31.269	22°–00′

This Easement gives an O G 0.250 greater and a G S 3.286 greater than Spiral No. 2½.

SPIRAL No. 3

Rad.	Angle	X	Y	S°	Versine	Sine
300	1°–00′	0.046	5.236	1°–00′	.00015	.01745
150	2°–00′	0.229	10.468	3°–00′	.00137	.05234
100	3°–00′	0.639	15.688	6°–00′	.00548	.10453
75	4°–00′	1.368	20.871	10°–00′	.01519	.17365
60	5°–00′	2.501	25.982	15°–00′	.03407	.25882
50	6°–00′	4.118	30.959	21°–00′	.06642	.35837
40	7°–00′	6.143	35.403	28°–00′	.11705	.46947

SWITCH EASEMENT S 3–100

Rad.	Angle	X	Y	S°
102⅓	6°–30′	0.658	11.584	6°–30′
81	8°–30′	1.368	16.480	10°–00′
60	5°–00′	2.501	21.591	15°–00′
50	6°–00′	4.118	26.568	21°–00′
40	7°–00′	6.143	31.012	28°–00′

This Easement gives an O G equal to and a G S 4.391 less than Spiral No. 3.

SWITCH EASEMENT S 3–200

Rad.	Angle	X	Y	S°
200	4°–00′	0.487	13.951	4°–00′
132	2°–00′	0.889	18.541	6°–00′
75	4°–00′	1.618	23.724	10°–00′
60	5°–00′	2.751	28.835	15°–00′
50	6°–00′	4.368	33.812	21°–00′
40	7°–00′	6.393	38.256	28°–00′

This Easement gives an O G 0.250 greater and a G S 2.853 greater than Spiral No. 3.

SPIRAL No. 4

Rad.	Angle	X	Y	S°	Versine	Sine
420	0°–42′	0.031	5.131	0°–42′	.00007	.01222
210	1°–24′	0.157	10.261	2°–06′	.00067	.03664
140	2°–06′	0.439	15.384	4°–12′	.00269	.07324
105	2°–48′	0.939	20.490	7°–00′	.00745	.12187
84	3°–30′	1.720	25.561	10°–30′	.01675	.18224
70	4°–12′	2.839	30.567	14°–42′	.03273	.25376
60	4°–54′	4.352	35.469	19°–36′	.05794	.33545

SWITCH EASEMENT S 4–200

Rad.	Angle	X	Y	S°
200	4°–00′	0.487	13.951	4°–00′
125½	3°–00′	1.117	20.490	7°–00′
84	3°–30′	1.898	25.561	10°–30′
70	4°–12′	3.017	30.567	14°–42′
60	4°–54′	4.530	35.469	19°–36′

This Easement gives an O G 0.178 greater and a G S equal to Spiral No. 4.

SPIRAL No. 5

Rad.	Angle	X	Y	S°	Versine	Sine
600	0°–30′	0.023	5.236	0°–30′	.00004	.00873
300	1°–00′	0.114	10.471	1°–30′	.00034	.02618
200	1°–30′	0.320	15.703	3°–00′	.00137	.05234
150	2°–00′	0.685	20.926	5°–00′	.00381	.08716
120	2°–30′	1.255	26.130	7°–30′	.00856	.13053
100	3°–00′	2.073	31.302	10°–30′	.01675	.18224
85	3°–30′	3.175	36.374	14°–00′	.02970	.24192

SWITCH EASEMENT S 5–200

Rad.	Angle	X	Y	S°
200	4°–00′	0.487	13.951	4°–00′
144	1°–00′	0.685	16.458	5°–00′
120	2°–30′	1.255	21.662	7°–30′
100	3°–00′	2.073	26.834	10°–30′
85	3°–30′	3.175	31.906	14°–00′

This Easement gives an O G equal to and a G S 4.468 less than Spiral No. 5.

SPIRAL No. 6

Rad.	Angle	X	Y	S°	Versine	Sine
900	0°–20′	0.015	5.236	0°–20′	.00002	.00582
450	0°–40′	0.076	10.472	1°–00′	.00015	.01745
300	1°–00′	0.213	15.706	2°–00′	.00061	.03490
225	1°–20′	0.457	20.936	3°–20′	.00169	.05814
180	1°–40′	0.837	26.158	5°–00′	.00381	.08716
150	2°–00′	1.385	31.365	7°–00′	.00745	.12187
128	2°–20′	2.125	36.524	9°–20′	.01324	.16218

SWITCH EASEMENT S 6–200

Rad.	Angle	X	Y	S°
200	4°–00′	0.487	13.951	4°–00′
255	1°–00′	0.837	18.388	5°–00′
150	2°–00′	1.385	23.595	7°–00′
128	2°–20′	2.125	28.754	9°–20′

This Easement gives an O G equal to and a G S 7.770 less than Spiral No. 6.

SPIRAL No. 7

Rad.	Angle	X	Y	S°	Versine	Sine
1260	0°–15′	0.012	5.498	0°–15′	.00001	.00436
630	0°–30′	0.060	10.995	0°–45′	.00009	.01309
420	0°–45′	0.168	16.492	1°–30′	.00034	.02618
315	1°–00′	0.360	21.987	2°–30′	.00095	.04362
252	1°–15′	0.660	27.475	3°–45′	.00214	.06540
210	1°–30′	1.091	32.957	5°–15′	.00420	.09150
180	1°–45′	1.678	38.424	7°–00′	.00745	.12187
157						

SPIRAL No. 8

Rad.	Angle	X	Y	S°	Versine	Sine
1890	0°–10′	0.008	5.498	0°–10′	.00000	.00291
945	0°–20′	0.040	10.996	0°–30′	.00004	.00873
630	0°–30′	0.112	16.493	1°–00′	.00015	.01745
472½	0°–40′	0.241	21.990	1°–40′	.00042	.02908
378	0°–50′	0.441	27.483	2°–30′	.00095	.04362
315	1°–00′	0.729	32.973	3°–30′	.00187	.06105
270	1°–10′	1.120	38.457	4°–40	.00332	.08136
236						

SPIRAL No. 9

Rad.	Angle	X	Y	S°	Versine	Sine
2730	0°– 7′	0.006	5.559	0°– 7′	.00000	.00204
1365	0°–14′	0.028	11.118	0°–21′	.00002	.00611
910	0°–21′	0.079	16.677	0°–42′	.00007	.01222
682½	0°–28′	0.170	22.234	1°–10′	.00021	.02036
546	0°–35′	0.311	27.791	1°–45′	.00047	.03054
455	0°–42′	0.515	33.346	2°–27′	.00091	.04275
390	0°–49′	0.792	38.899	3°–16′	.00162	.05698
341						

SPIRAL No. 10

Rad.	Angle	X	Y	S°	Versine	Sine
3780	0°–05′	0.004	5.498	0°–05′	.00000	.00145
1890	0°–10′	0.020	10.996	0°–15′	.00001	.00436
1260	0°–15′	0.056	16.493	0°–30′	.00004	.00873
945	0°–20′	0.120	21.991	0°–50′	.00011	.01454
756	0°–25′	0.220	27.488	1°–15′	.00024	.02181
630	0°–30′	0.364	32.983	1°–45′	.00047	.03054
540	0°–35′	0.560	38.478	2°–20′	.00083	.04071
472						

SPIRAL No. 11

Rad.	Angle	X	Y	S°	Versine	Sine
5250	0°–04′	.0035	6.109	0°–04′	.00000	.00116
2625	0°–08′	.0178	12.217	0°–12′	.00001	.00349
1750	0°–12′	.0498	18.326	0°–24′	.00002	.00698
1312½	0°–16′	.1066	24.434	0°–40′	.00007	.01164
1050	0°–20′	.1955	30.542	1°–00′	.00015	.01745
875	0°–24′	.3234	36.649	1°–24′	.00030	.02443
750	0°–28′	.4975	42.756	1°–52′	.00053	.03257
656						

SPIRAL No. 12

Rad.	Angle	X	Y	S°	Versine	Sine
7140	0°–03′	.0027	6.231	0°–03′	.00000	.00087
3570	0°–06′	.0136	12.462	0°–09′	.00000	.00262
2380	0°–09′	.0381	18.692	0°–18′	.00001	.00524
1785	0°–12′	.0816	24.923	0°–30′	.00004	.00873
1428	0°–15′	.1495	31.153	0°–45′	.00009	.01309
1190	0°–18′	.2474	37.384	1°–03′	.00017	.01832
1020	0°–21′	.3806	43.613	1°–24′	.00030	.02443
892						

Tables giving elements of

SPIRALS

for

Inner Gage Line Lengths

of Rails and

Tie Rod Spacing for

Various Gages.

SPIRAL No. 2. GAGE, 4 FT. 8½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	300	0°–30′	0.011	2.597	0°–30′	.00004	.00873	2.639	2.597	.001
2	150	1°–00′	0.056	5.173	1°–30′	.00034	.02618	5.298	5.174	.002
3	100	1°–30′	0.157	7.728	3°–00′	.00137	.05234	7.977	7.731	.005
4	75	2°–00′	0.333	10.258	5°–00′	.00381	.08716	10.677	10.267	.008
5	60	2°–30′	0.607	12.758	7°–30′	.00856	.13053	13.398	12.782	.012
6	50	3°–00′	0.997	15.222	10°–30′	.01675	.18224	16.139	15.277	.016
7	42½	3°–30′	1.517	17.618	14°–00′	.02970	.24192	18.879	17.729	.022
8	37½	4°–00′	2.194	19.976	18°–00′	.04894	.30902	21.662	20.182	.028
	33⅓									

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
.99	1.01	5.92	6.08	10.77	11.23	15.55	16.45
1.98	2.02	6.90	7.10	11.74	12.26	16.50	17.50
2.97	3.03	7.87	8.13	12.70	13.30	17.44	18.56
3.96	4.04	8.84	9.16	13.65	14.35	18.38	19.62
4.94	5.06	9.81	10.19	14.60	15.40	19.32	20.68

SWITCH EASEMENT S 2–75. GAGE, 4 FT. 8½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Length Outer	Length Inner	Correction for T Rail	
			X	Y					
	75	7°–50′	.678	9.901	7°–50′	10.576	9.932	.012	This Easement gives an O G equal to and a G S 3.346 less than Spiral No. 2.
6	45⅓	2°–40′	.997	11.876	10°–30′	12.795	11.933	.016	
7	42½	3°–30′	1.517	14.272	14°–00′	15.535	14.385	.022	
8	37½	4°–00′	2.194	16.630	18°–00′	18.318	16.838	.028	

SPIRAL No. 2½. GAGE, 4 FT. 8½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	444	0°–20′	.007	2.569	0°–20′	.00002	.00582	2.597	2.569	0.000
2	222	0°–40′	.038	5.125	1°–00′	.00015	.01745	5.207	5.125	0.002
3	148	1°–00′	0.104	7.666	2°–00′	.00061	.03490	7.881	7.667	0.003
4	111	1°–20′	0.222	10.191	3°–20′	.00169	.05814	10.469	10.195	0.005
5	89	1°–40′	0.405	12.705	5°–00′	.00381	.08716	13.126	12.716	0.008
6	74	2°–00′	0.666	15.191	7°–00′	.00745	.12187	15.792	15.216	0.011
7	63½	2°–20′	1.020	17.656	9°–20′	.01324	.16218	18.473	17.707	0.015
8	55½	2°–40′	1.478	20.087	12°–00′	.02185	.20791	21.166	20.180	0.019
9	49	3°–00′	2.048	22.461	15°–00′	.03407	.25882	23.855	22.623	0.024
10	44½	3°–20′	2.751	24.810	18°–20′	.05076	.31454	26.581	25.075	0.029
11	40½	3°–40′	3.592	27.101	22°–00′	.07282	.37461	29.324	27.516	0.035

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
1.00	1.00	5.95	6.05	10.85	11.15	15.69	16.31	20.49	21.51	25.24	26.76
1.99	2.01	6.93	7.07	11.82	12.18	16.66	17.34	21.44	22.56	26.18	27.82
2.98	3.02	7.91	8.09	12.79	13.21	17.62	18.38	22.40	23.60	27.12	28.88
3.97	4.03	8.89	9.11	13.76	14.24	18.58	19.42	23.34	24.66		
4.96	5.04	9.87	10.13	14.73	15.27	19.54	20.46	24.29	25.71		

SWITCH EASEMENT S 2½–100. GAGE, 4 FT. 8½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail X	Inner Rail Y	S°	Length Outer	Length Inner	Correction for T Rail
	102⅓	6°-30′	0.643	11.318	6°-30′	11.876	11.342	.010
8	56½	5°-30′	1.478	16.447	12°-00′	17.526	16.540	.019
9	49	3°-00′	2.048	18.821	15°-00′	20.215	18.983	.024
10	44½	3°-20′	2.751	21.170	18°-20′	22.940	21.434	.029
11	40½	3°-40′	3.592	23.461	22°-00′	25.683	23.875	.035

This Easement gives an O G equal to and a G S 3.640 less than Spiral No. 2½.

SWITCH EASEMENT S 2½–200. GAGE, 4 FT. 8½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail X	Inner Rail Y	S°	Length Outer	Length Inner	Correction for T Rail
	200	4°-00′	0.481	13.787	4°-00′	14.127	13.799	.006
5	129	1°-00′	0.655	15.991	5°-00′	16.419	16.009	.008
6	74	2°-00′	0.916	18.477	7°-00′	19.085	18.509	.011
7	63½	2°-20′	1.270	20.942	9°-20′	21.766	21.000	.014
8	55½	2°-40′	1.728	23.373	12°-00′	24.459	23.473	.019
9	49	3°-00′	2.298	25.747	15°-00′	27.148	25.916	.024
10	44½	3°-20′	3.001	28.096	18°-20′	29.874	28.868	.029
11	40½	3°-40′	3.842	30.387	22°-00′	32.617	30.809	.035

This Easement gives an O G 0.250 greater and a G S 3.286 greater than Spiral No. 2½.

SPIRAL No. 3. GAGE, 4 FT. 8½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	300	1°–0′	0.046	5.195	1°–0′	.00015	.01745	5.277	5.195	.002
2	150	2°–0′	0.226	10.345	3°–0′	.00187	.05234	10.595	10.349	.005
3	100	3°–0′	0.626	15.442	6°–0′	.00548	.10453	15.954	15.461	.009
4	75	4°–0′	1.332	20.462	10°–0′	.01519	.17365	21.355	20.533	.016
5	60	5°–0′	2.421	25.373	15°–0′	.03407	.25882	26.796	25.564	.024
6	50	6°–0′	3.962	30.115	21°–0′	.06642	.35837	32.279	30.553	.033
7	40	7°–0′	5.867	34.298	28°–0′	.11705	.46947	37.453	35.153	.044
	35									

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
.99	1.01	6.93	7.07	12.82	13.18	18.65	19.35	24.43	25.57	30.16	31.84
1.98	2.02	7.92	8.08	13.79	14.21	19.62	20.38	25.39	26.61	31.10	32.90
2.98	3.02	8.90	9.10	14.77	15.23	20.59	21.41	26.34	27.66	32.04	33.96
3.97	4.03	9.88	10.12	15.74	16.26	21.55	22.45	27.30	28.70	32.99	35.01
4.96	5.04	10.86	11.14	16.71	17.29	22.51	23.49	28.25	29.75	33.96	36.07
5.95	6.05	11.84	12.16	17.68	18.32	23.47	24.53	29.20	30.80	34.87	37.13

SWITCH EASEMENT S 3–100. GAGE, 4 FT. 8½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Length Outer	Length Inner	Correction for T Rail	
			X	Y					
	102⅓	6°–30′	0.643	11.318	6°–30′	11.876	11.342	.010	This Easement gives an O G equal to and a G S 4.391 less than Spiral No. 3.
4	81	8°–30′	1.332	16.071	10°–00′	16.968	16.146	.016	
5	60	5°–00′	2.421	20.982	15°–00′	22.409	21.177	.024	
6	50	6°–00′	3.962	25.724	21°–00′	27.892	26.166	.033	
7	40	7°–00′	5.867	29.907	28°–00′	33.066	30.766	.044	

SWITCH EASEMENT S 3–200. GAGE, 4 FT. 8½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Length Outer	Length Inner	Correction for T Rail	
			X	Y					
	200	4°–00′	0.481	13.787	4°–00′	14.127	13.799	.006	This Easement gives an O G 0.250 greater and a G S 2.853 greater than Spiral No. 3.
3	132	2°–00′	0.876	18.295	6°–00′	18.817	18.323	.009	
4	75	4°–00′	1.582	23.315	10°–00′	24.217	23.395	.016	
5	60	5°–00′	2.671	28.226	15°–00′	29.658	28.426	.024	
6	50	6°–00′	4.212	32.968	21°–00′	35.141	33.415	.033	
7	40	7°–00′	6.117	37.151	28°–00′	40.315	38.015	.044	

SPIRAL No. 4. GAGE, 4 FT. 8½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	420	0°-42′	0.031	5.102	0°-42′	.00007	.01222	5.160	5.102	.001
2	210	1°-24′	0.155	10.175	2°-06′	.00067	.03664	10.349	10.177	.003
3	140	2°-06′	0.433	15.212	4°-12′	.00269	.07324	15.567	15.221	.007
4	105	2°-48′	0.921	20.203	7°-00′	.00745	.12187	20.813	20.237	.011
5	84	3°-30′	1.681	25.132	10°-30′	.01675	.18224	26.087	25.225	.016
6	70	4°-12′	2.762	29.970	14°-42′	.03273	.25376	31.392	30.184	.023
7	60	4°-54′	4.216	34.679	19°-36′	.05794	.33545	36.724	35.114	.031
	52½									

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
0.99	1.01	6.95	7.05	12.87	13.13	18.75	19.25	24.59	25.41	30.39	31.61
1.99	2.01	7.94	8.06	13.85	14.15	19.72	20.28	25.56	26.44	31.35	32.65
2.98	3.02	8.93	9.07	14.83	15.17	20.70	21.30	26.52	27.48	32.31	33.69
3.98	4.02	9.92	10.08	15.81	16.19	21.67	22.33	27.49	28.51	33.27	34.73
4.97	5.03	10.90	11.10	16.79	17.21	22.64	23.36	28.46	29.54	34.23	35.77
5.96	6.04	11.89	12.11	17.77	18.23	23.62	24.39	29.42	30.58		

SWITCH EASEMENT S 4–200. GAGE, 4 FT. 8½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Length Outer	Length Inner	Correction for T Rail	
			X	Y					
	200	4°–00′	0.481	13.787	4°–00′	14.127	13.799	.006	This Easement gives an O G 0.178 greater and a G S equal to Spiral No. 4.
4	125½	3°–00′	1.099	20.203	7°–00′	20.822	20.246	.011	
5	84	3°–30′	1.859	25.132	10°–30′	26.096	25.234	.016	
6	70	4°–12′	2.940	29.970	14°–42′	31.400	30.192	.023	
7	60	4°–54′	4.394	34.679	19°–36′	36.733	35.123	.031	

SPIRAL No. 5. GAGE, 4 FT. 8½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	600	0°–30′	.023	5.215	0°–30′	.00004	.00873	5.257	5.215	.001
2	300	1°–00′	.113	10.409	1°–30′	.00034	.02618	10.534	10.410	.002
3	200	1°–30′	.317	15.580	3°–00′	.00137	.05234	15.831	15.585	.005
4	150	2°–00′	.676	20.721	5°–00′	.00381	.08716	21.149	20.739	.008
5	120	2°–30′	1.235	25.823	7°–30′	.00856	.13053	26.488	25.872	.012
6	100	3°–00′	2.034	30.873	10°–30′	.01675	.18224	31.847	30.985	.016
7	85	3°–30′	3.105	35.805	14°–00′	.02970	.24192	37.183	36.033	.022
	75									

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
1.00	1.00	6.97	7.03	12.91	13.09	18.83	19.17	24.72	25.28	30.58	31.42
1.99	2.01	7.96	8.04	13.90	14.10	19.81	20.19	25.70	26.30	31.55	32.45
2.99	3.01	8.95	9.05	14.88	15.12	20.79	21.21	26.67	27.33	32.53	33.47
3.98	4.02	9.94	10.06	15.87	16.13	21.77	22.23	27.65	28.35	33.50	34.50
4.98	5.02	10.93	11.07	16.86	17.14	22.75	23.25	28.63	29.37	34.47	35.53
5.97	6.03	11.92	12.08	17.84	18.16	23.74	24.26	29.60	30.40	35.44	36.56

SWITCH EASEMENT S 5–200. GAGE, 4 FT. 8½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Length Outer	Length Inner	Correction for T Rail	
			X	Y					
	200	4°–00′	0.481	13.787	4°–00′	14.127	13.799	.006	This Easement gives an O G equal to and a G S 4.468 less than Spiral No. 5.
4	144	1°–00′	0.676	16.253	5°–00′	16.681	16.271	.008	
5	120	2°–30′	1.235	21.355	7°–30′	22.020	21.404	.012	
6	100	3°–00′	2.034	26.405	10°–30′	27.379	26.517	.016	
7	85	3°–30′	3.105	31.337	14°–00′	32.715	31.565	.022	

SPIRAL No. 6. GAGE, 4 FT. 8½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	900	0°–20′	0.015	5.222	0°–20′	.00002	.00582	5.250	5.222	.001
2	450	0°–40′	0.076	10.431	1°–00′	.00015	.01745	10.513	10.431	.002
3	300	1°–00′	0.212	15.624	2°–00′	.00061	.03490	15.790	15.626	.003
4	225	1°–20′	0.453	20.799	3°–20′	.00169	.05814	21.081	20.807	.005
5	180	1°–40′	0.828	25.953	5°–00′	.00381	.08716	26.385	25.975	.008
6	150	2°–00′	1.367	31.078	7°–00′	.00745	.12187	31.704	31.128	.011
7	128 112½	2°–20′	2.094	36.142	9°–20′	.01324	.16218	37.012	36.246	.015

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
1.00	1.00	6.98	7.02	12.94	13.06	18.88	19.12	24.81	25 19	30.72	31.28
1.99	2.01	7.97	8.03	13.93	14.07	19.87	20.13	25.80	26.20	31.70	32.30
2.99	3.01	8.97	9.03	14.92	15.08	20.86	21.14	26.78	27.22	32.68	33.32
3.99	4.01	9.96	10.04	15.91	16.09	21.85	22.15	27.77	28.23	33.66	34.34
4.99	5.01	10.95	11.05	16.90	17.10	22.84	23.16	28.75	29.25	34.65	35.35
5.98	6.02	11.95	12.05	17.89	18.11	23.82	24.18	29.73	30.27	35.63	36.37

SWITCH EASEMENT S 6–200. GAGE, 4 FT. 8½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Length Outer	Length Inner	Correction for T Rail	
			X	Y					
	200	4°–00′	0.481	13.787	4°–00′	14.127	13.799	.006	This Easement gives an O G equal to and a G S 7.770 less than Spiral No. 6.
5	255	1°–00′	0.828	18.183	5°–00′	18.618	18.208	.008	
6	150	2°–00′	1.367	23.308	7°–00′	23.937	23.361	.011	
7	128	2°–20′	2.094	28.372	9°–20′	29.245	28.479	.015	

SPIRAL No. 2. GAGE, 5 FT.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	300	0°-30′	0.011	2.596	0°-30′	.00004	.00873	2.640	2.596	.001
2	150	1°-00′	0.056	5.170	1°-30′	.00034	.02618	5.301	5.171	.002
3	100	1°-30′	0.157	7.720	3°-00′	.00137	.05234	7.985	7.723	.005
4	75	2°-00′	0.332	10.245	5°-00′	.00381	.08716	10.690	10.254	.008
5	60	2°-30′	0.606	12.739	7°-30′	.00856	.13053	13.417	12.763	.012
6	50	3°-00′	0.994	15.195	10°-30′	.01675	.18224	16.166	15.250	.016
7	42½	3°-30′	1.513	17.582	14°-00′	.02970	.24192	18.915	17.698	.022
8	37½ 33⅓	4°-00′	2.187	19.930	18°-00′	.04894	.30902	21.707	20.137	.028

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
.99	1.01	5.92	6.08	10.76	11.24	15.53	16.48
1.98	2.02	6.89	7.11	11.72	12.28	16.47	17.53
2.97	3.03	7.86	8.14	12.68	13.32	17.41	18.59
3.96	4.04	8.83	9.17	13.63	14.37	18.34	19.66
4.94	5.06	9.80	10.20	14.58	15.42	19.28	20.72

SWITCH EASEMENT S 2-75. GAGE, 5 FT.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Length Outer	Length Inner	Correction for T Rail	
			X	Y					
	75	7°–50′	.677	9.881	7°–50′	10.596	9.912	.012	This Easement gives an O G equal to and a G S 3.346 less than Spiral No. 2.
6	45⅓	2°–40′	.994	11.849	10°–30′	12.822	11.906	.016	
7	42½	3°–30′	1.513	14.236	14°–00′	15.571	14.349	.022	
8	37½	4°–00′	2.187	16.584	18°–00′	18.363	16.793	.028	

SPIRAL No. 2½. GAGE, 5 FT.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	444	0°–20′	.007	2.568	0°–20′	.00002	.00582	2.598	2.568	0.000
2	222	0°–40′	.038	5.122	1°–00′	.00015	.01745	5.210	5.122	0.002
3	148	1°–00′	0.103	7.661	2°–00′	.00061	.03490	7.836	7.662	0.003
4	111	1°–20′	0.232	10.183	3°–20′	.00169	.05814	10.477	10.187	0.005
5	89	1°–40′	0.404	12.692	5°–00′	.00381	.08716	13.139	12.703	0.008
6	74	2°–00′	0.665	15.173	7°–00′	.00745	.12187	15.809	15.199	0.011
7	63½	2°–20′	1.018	17.633	9°–20′	.01324	.16218	18.497	17.683	0.015
8	55½	2°–40′	1.474	20.056	12°–00′	.02185	.20791	21.197	20.149	0.019
9	49	3°–00′	2.043	22.423	15°–00′	.03407	.25882	23.893	22.585	0.024
10	44½	3°–20′	2.743	24.764	18°–20′	.05076	.31454	26.628	25.028	0.029
11	40½	3°–40′	3.581	27.046	22°–00′	.07282	.37461	29.380	27.460	0.035

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
1.00	1.00	5.94	6.06	10.84	11.16	15.68	16.32	20.46	21.54	25.19	26.81
1.99	2.01	6.93	7.07	11.81	12.19	16.64	17.36	21.41	22.59	26.13	27.87
2.98	3.02	7.91	8.09	12.78	13.22	17.60	18.40	22.36	23.64	27.07	28.93
3.97	4.03	8.89	9.11	13.75	14.25	18.55	19.45	23.30	24.70		
4.96	5.04	9.86	10.14	14.71	15.29	19.51	20.49	24.25	25.75		

SWITCH EASEMENT S 2½–100. GAGE, 5 FT.

Point No.	Cent. Rad.	Angle	Inner Rail X	Inner Rail Y	S°	Length Outer	Length Inner	Correction for T Rail	
	102½	6°–30′	0.642	11.301	6°–30′	11.893	11.325	.010	This Easement gives an O G equal to and a G S 3.640 less than Spiral No. 2½.
8	56½	5°–30′	1.474	16.416	12°–00′	17.557	16.509	.019	
9	49	3°–00′	2.043	18.783	15°–00′	20.254	18.944	.024	
10	44½	3°–20′	2.743	21.124	18°–20′	22.987	21.387	.029	
11	40½	3°–40′	3.581	23.406	22°–00′	25.739	23.819	.035	

SWITCH EASEMENT S 2½–200. GAGE, 5 FT.

Point No.	Cent. Rad.	Angle	Inner Rail X	Inner Rail Y	S°	Length Outer	Length Inner	Correction for T Rail	
	200	4°–00′	0.481	13.777	4°–00′	14.138	13.788	.006	This Easement gives an O G 0.250 greater and a G S 3.286 greater than Spiral No. 2½.
5	129	1°–00′	0.654	15.978	5°–00′	16.432	15.996	.008	
6	74	2°–00′	0.915	18.459	7°–00′	19.102	18.492	.011	
7	63½	2°–20′	1.268	20.919	9°–20′	21.790	20.976	.014	
8	55½	2°–40′	1.724	23.342	12°–00′	24.490	23.442	.019	
9	49	3°–00′	2.293	25.709	15°–00′	27.186	25.878	.024	
10	44½	3°–20′	2.993	28.050	18°–20′	29.921	28.321	.029	
11	40½	3°–40′	3.831	30.332	22°–00′	32.673	30.753	.035	

SPIRAL No. 3. GAGE, 5 FT.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	300	1°-00′	0.046	5.192	1°-00′	.00015	.01745	5.280	5.192	.002
2	150	2°-00′	0.226	10.337	3°-00′	.00137	.05234	10.603	10.341	.005
3	100	3°-00′	0.625	15.427	6°-00′	.00548	.10453	15.970	15.446	.009
4	75	4°-00′	1.330	20.437	10°-00′	.01519	.17365	21.380	20.508	.016
5	60	5°-00′	2.416	25.335	15°-00′	.03407	.25882	26.834	25.526	.024
6	50	6°-00′	3.952	30.063	21°-00′	.06642	.35837	32.332	30.500	.033
7	40	7°-00′	5.850	34.229	28°-00′	.11705	.46947	37.524	35.082	.044
	35									

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
.99	1.01	6.93	7.07	12.81	13.19	18.63	19.37	24.40	25.60	30.11	31.89
1.98	2.02	7.91	8.09	13.78	14.22	19.60	20.40	25.35	26.65	31.05	32.95
2.98	3.02	8.89	9.11	14.76	15.24	20.56	21.44	26.31	27.69	31.99	34.01
3.97	4.03	9.88	10.12	15.73	16.27	21.52	22.48	27.26	28.74	32.92	35.08
4.96	5.04	10.86	11.14	16.70	17.30	22.48	23.52	28.21	29.79	33.86	36.14
5.94	6.06	11.83	12.17	17.66	18.34	23.44	24.56	29.16	30.84	34.80	37.20

SWITCH EASEMENT S 3–100. GAGE, 5 FT.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Length Outer	Length Inner	Correction for T Rail	
			X	Y					
	102⅓	6°–30′	0.642	11.301	6°–30′	11.893	11.325	.010	This Easement gives an O G equal to and a G S 4.391 less than Spiral No. 3.
4	81	3°–30′	1.330	16.046	10°–00′	16.993	16.121	.016	
5	60	5°–00′	2.416	20.944	15°–00′	22.447	21.139	.024	
6	50	6°–00′	3.952	25.672	21°–00′	27.945	26.113	.033	
7	40	7°–00′	5.850	29.838	28°–00′	33.138	30.694	.044	

SWITCH EASEMENT S 3–200. GAGE, 5 FT.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Length Outer	Length Inner	Correction for T Rail	
			X	Y					
	200	4°–00′	0.481	13.777	4°–00′	14.138	13.788	.006	This Easement gives an O G 0.250 greater and a G S 2.853 greater than Spiral No. 3.
3	132	2°–00′	0.875	18.280	6°–00′	18.832	18.308	.009	
4	75	4°–00′	1.580	23.290	10°–00′	24.242	23.370	.016	
5	60	5°–00′	2.666	28.188	15°–00′	29.696	28.388	.024	
6	50	6°–00′	4.202	32.916	21°–00′	35.194	33.362	.033	
7	40	7°–00′	6.100	37.082	28°–00′	40.387	37.943	.044	

SPIRAL No. 4. GAGE, 5 FT.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	420	0°–42′	0.031	5.100	0°–42′	.00007	.01222	5.162	5.100	.001
2	210	1°–24′	0.155	10.169	2°–06′	.00067	.03664	10.355	10.171	.003
3	140	2°–06′	0.432	15.201	4°–12′	.00269	.07324	15.577	15.211	.007
4	105	2°–48′	0.920	20.185	7°–00′	.00745	.12187	20.830	20.220	.011
5	84	3°–30′	1.678	25.105	10°–30′	.01675	.18224	26.114	25.198	.016
6	70	4°–12′	2.757	29.933	14°–42′	.03273	.25376	31.429	30.147	.023
7	60	4°–54′	4.207	34.630	19°–36′	.05794	.33545	36.774	35.064	.031
	52½									

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
0.99	1.01	6.95	7.05	12.86	13.14	18.73	19.27	24.56	25.44	30.35	31.65
1.99	2.01	7.94	8.06	13.84	14.16	19.71	20.29	25.53	26.47	31.31	32.69
2.98	3.02	8.92	9.08	14.82	15.18	20.68	21.32	26.49	27.51	32.27	33.73
3.98	4.02	9.91	10.09	15.80	16.20	21.65	22.35	27.46	28.54	33.22	34.78
4.97	5.03	10.89	11.11	16.78	17.22	22.62	23.38	28.42	29.58	34.18	35.82
5.96	6.04	11.88	12.12	17.76	18.24	23.59	24.41	29.39	30.61		

SWITCH EASEMENT S 4–200. GAGE, 5 FT.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Length Outer	Length Inner	Correction for T Rail	
			X	Y					
	200	4°–00′	0.481	13.777	4°–00′	14.138	13.788	.006	This Easement gives an O G 0.178 greater and a G S equal to Spiral No. 4.
4	125½	3°–00′	1.098	20.185	7°–00′	20.839	20.229	.011	
5	84	3°–30′	1.856	25.105	10°–30′	26.123	25.207	.016	
6	70	4°–12′	2.935	29.933	14°–42′	31.437	30.155	.023	
7	60	4°–54′	4.385	34.630	19°–36′	36.783	35.073	.031	

SPIRAL No. 5. GAGE, 5 FT.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	600	0°-30′	.023	5.214	0°-30′	.00004	.00873	5.258	5.214	.001
2	300	1°-00′	.113	10.406	1°-30′	.00034	.02618	10.537	10.407	.002
3	200	1°-30′	.317	15.572	3°-00′	.00137	.05234	15.839	15.577	.005
4	150	2°-00′	.675	20.708	5°-00′	.00381	.08716	21.162	20.726	.008
5	120	2°-30′	1.234	25.804	7°-30′	.00856	.13053	26.507	25.853	.012
6	100	3°-00′	2.031	30.846	10°-30′	.01675	.18224	31.874	30.958	.016
7	85	3°-30′	3.101	35.769	14°-00′	.02970	.24192	37.219	35.997	.022
	75									

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
1.00	1.00	6.96	7.04	12.90	13.10	18.81	19.19	24.70	25.30	30.55	31.45
1.99	2.01	7.96	8.04	13.89	14.11	19.80	20.20	25.68	26.32	31.53	32.47
2.99	3.01	8.95	9.05	14.88	15.12	20.78	21.22	26.65	27.35	32.50	33.50
3.98	4.02	9.94	10.06	15.86	16.14	21.76	22.24	27.63	28.37	33.47	34.53
4.98	5.02	10.93	11.07	16.85	17.15	22.74	23.26	28.60	29.40	34.44	35.56
5.97	6.03	11.92	12.08	17.83	18.17	23.72	24.28	29.58	30.42	35.41	36.59

SWITCH EASEMENT S 5–200. GAGE, 5 FT.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Length Outer	Length Inner	Correction for T Rail	
			X	Y					
	200	4°–00′	0.481	13.777	4°–00′	14.138	13.788	.006	This Easement gives an O G equal to and a G S 4.468 less than Spiral No. 5.
4	144	1°–00′	0.675	16.240	5°–00′	16.694	16.258	.008	
5	120	2°–30′	1.234	21.336	7°–30′	22.039	21.385	.012	
6	100	3°–00′	2.031	26.378	10°–30′	27.406	26.490	.016	
7	85	3°–30′	3.101	31.301	14°–00′	32.751	31.529	.022	

SPIRAL No. 6. GAGE, 5 FT.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	900	0°-20′	0.015	5.221	0°-20′	.00002	.00582	5.251	5.221	.001
2	450	0°-40′	0.076	10.428	1°-00′	.00015	.01745	10.516	10.428	.002
3	300	1°-00′	0.211	15.619	2°-00′	.00061	.03490	15.795	15.621	.008
4	225	1°-20′	0.453	20.791	3°-20′	.00169	.05814	21.089	20.799	.005
5	180	1°-40′	0.828	25.940	5°-00′	.00381	.08716	26.398	25.962	.008
6	150	2°-00′	1.366	31.060	7°-00′	.00745	.12187	31.721	31.111	.011
7	128	2°-20′	2.092	36.119	9°-20′	.01324	.16218	37.086	36.222	.015
	112½									

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
1.00	1.00	6.98	7.02	12.94	13.06	18.88	19.12	24.80	25.20	30.70	31.30
1.99	2.01	7.97	8.03	13.93	14.07	19.87	20.13	25.78	26.22	31.68	32.32
2.99	3.01	8.96	9.04	14.92	15.08	20.85	21.15	26.77	27.23	32.66	33.34
3.99	4.01	9.96	10.04	15.91	16.09	21.84	22.16	27.75	28.25	33.64	34.36
4.99	5.01	10.95	11.05	16.90	17.10	22.83	23.17	28.73	29.27	34.63	35.37
5.98	6.02	11.94	12.06	17.89	18.11	23.81	24.19	29.72	30.28	35.61	36.39

SWITCH EASEMENT S 6–200. GAGE, 5 FT.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Length Outer	Length Inner	Correction for T Rail	
			X	Y					
	200	4°–00′	0.481	13.777	4°–00′	14.138	13.788	.006	This Easement gives an O G equal to and a G S 7.770 less than Spiral No. 6.
5	255	1°–00′	0.828	18.170	5°–00′	18.631	18.195	.008	
6	150	2°–00′	1.366	23.290	7°–00′	23.954	23.344	.011	
7	128	2°–20′	2.092	28.349	9°–20′	29.269	28.455	.015	

SPIRAL No. 2. GAGE, 5 FT. 2½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	300	0°-30′	0.011	2.595	0°-30′	.00004	.00873	2.641	2.595	.001
2	150	1°-00′	0.056	5.167	1°-30′	.00034	.02618	5.304	5.168	.002
3	100	1°-30′	0.156	7.715	3°-00′	.00137	.05234	7.990	7.718	.005
4	75	2°-00′	0.332	10.236	5°-00′	.00381	.08716	10.699	10.245	.008
5	60	2°-30′	0.605	12.725	7°-30′	.00856	.13053	13.431	12.749	.012
6	50	3°-00′	0.992	15.176	10°-30′	.01675	.18224	16.185	15.231	.016
7	42⅞	3°-30′	1.510	17.557	14°-00′	.02970	.24192	18.940	17.668	.022
8	37½	4°-00′	2.182	19.898	18°-00′	.04894	.30902	21.740	20.104	.028
	33⅓									

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
.99	1.01	5.91	6.09	10.75	11.25	15.51	16.49
1.98	2.02	6.89	7.11	11.70	12.29	16.44	17.56
2.97	3.03	7.86	8.14	12.66	13.34	17.38	18.62
3.95	4.05	8.82	9.18	13.61	14.39	18.32	19.68
4.94	5.06	9.79	10.21	14.56	15.44	19.25	20.75

SWITCH EASEMENT S 2–75. GAGE, 5 FT. 2½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Length Outer	Length Inner	Correction for T Rail
			X	Y				
	75	7°–50′	.676	9.867	7°–50′	10.610	9.898	.012
6	45⅓	2°–40′	.992	11.830	10°–30′	12.841	11.887	.016
7	42½	3°–30′	1.510	14.211	14°–00′	15.596	14.324	.022
8	37½	4°–00′	2.182	16.552	18°–00′	18.396	16.760	.028

This Easement gives an O G equal to and a G S 3.346 less than Spiral No. 2.

SPIRAL No. 2½. GAGE, 5 FT. 2½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	444	0°-20′	0.007	2.568	0°-20′	.00002	.00582	2.598	2.568	0.000
2	222	0°-40′	0.038	5.121	1°-00′	.00015	.01745	5.211	5.121	0.002
3	148	1°-00′	0.103	7.657	2°-00′	.00061	.03490	7.840	7.658	0.003
4	111	1°-20′	0.222	10.177	3°-20′	.00169	.05814	10.484	10.180	0.005
5	89	1°-40′	0.404	12.683	5°-00′	.00381	.08716	13.148	12.694	0.008
6	74	2°-00′	0.665	15.161	7°-00′	.00745	.12187	15.822	15.186	0.011
7	63½	2°-20′	1.017	17.616	9°-20′	.01324	.16218	18.514	17.666	0.015
8	55½	2°-40′	1.472	20.035	12°-00′	.02185	.20791	21.218	20.128	0.019
9	49	3°-00′	2.039	22.396	15°-00′	.03407	.25882	23.921	22.557	0.024
10	44½	3°-20′	2.738	24.731	18°-20′	.05076	.31454	26.661	24.995	0.029
11	40½	3°-40′	3.573	27.008	22°-00′	.07282	.37461	29.420	27.420	0.035

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
.99	1.01	5.94	6.06	10.83	11.17	15.66	16.34	20.44	21.56	25.16	26.84
1.99	2.01	6.92	7.08	11.80	12.20	16.62	17.38	21.38	22.62	26.09	27.91
2.98	3.02	7.90	8.10	12.77	13.23	17.58	18.42	22.33	23.67	27.03	28.97
3.97	4.03	8.88	9.12	13.73	14.27	18.53	19.47	23.27	24.73		
4.96	5.04	9.86	10.14	14.70	15.30	19.49	20.51	24.22	25.78		

SWITCH EASEMENT S 2½–100. GAGE, 5 FT. 2½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail X	Inner Rail Y	S°	Length Outer	Length Inner	Correction for T Rail	
	102⅓	6°-30′	0.641	11.289	6°-30′	11.904	11.314	.010	This Easement gives an O G equal to and a G S 3.640 less than Spiral No. 2½.
8	56½	5°-30′	1.472	16.395	12°-00′	17.578	16.488	.019	
9	49	3°-00′	2.039	18.756	15°-00′	20.281	18.917	.024	
10	44½	3°-20′	2.738	21.091	18°-20′	23.020	21.354	.029	
11	40½	3°-40′	3.573	23.368	22°-00′	25.779	23.779	.035	

SWITCH EASEMENT S 2½–200. GAGE, 5 FT. 2½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail X	Inner Rail Y	S°	Length Outer	Length Inner	Correction for T Rail	
	200	4°-00′	0.481	13.769	4°-00′	14.145	13.781	.006	This Easement gives an O G 0.250 greater and a G S 3.286 greater than Spiral No. 2½.
5	129	1°-00′	0.654	15.969	5°-00′	16.441	15.987	.008	
6	74	2°-00′	0.915	18.447	7°-00′	19.115	18.479	.011	
7	63½	2°-20′	1.267	20.902	9°-20′	21.807	20.959	.014	
8	55½	2°-40′	1.722	23.321	12°-00′	24.511	23.421	.019	
9	49	3°-00′	2.289	25.682	15°-00′	27.214	25.850	.024	
10	44½	3°-20′	2.988	28.017	18°-20′	29.954	28.288	.029	
11	40½	3°-40′	3.823	30.294	22°-00′	32.713	30.713	.035	

SPIRAL No. 3. GAGE, 5 FT. 2½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	300	1°-0′	0.046	5.191	1°-0′	.00015	.01745	5.281	5.191	.002
2	150	2°-0′	0.225	10.332	3°-0′	.00137	.05234	10.608	10.336	.005
3	100	3°-0′	0.625	15.416	6°-0′	.00548	.10453	15.981	15.435	.009
4	75	4°-0′	1.328	20.419	10°-0′	.01519	.17365	21.399	20.489	.016
5	60	5°-0′	2.412	25.308	15°-0′	.03407	.25882	26.862	25.498	.024
6	50	6°-0′	3.945	30.026	21°-0′	.06642	.35837	32.371	30.461	.033
7	40	7°-0′	5.838	34.181	28°-0′	.11705	.46947	37.576	35.080	.044
	35									

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
.99	1.01	6.92	7.08	12.80	13.20	18.61	19.39	24.37	25.63	30.07	31.93
1.98	2.02	7.91	8.09	13.77	14.23	19.58	20.42	25.33	26.67	31.01	32.99
2.97	3.03	8.89	9.11	14.75	15.25	20.54	21.46	26.28	27.72	31.94	34.06
3.97	4.03	9.87	10.13	15.72	16.28	21.50	22.50	27.22	28.78	32.88	35.12
4.96	5.04	10.85	11.15	16.68	17.32	22.46	23.54	28.17	29.83	33.81	36.19
5.94	6.06	11.82	12.18	17.65	18.35	23.41	24.59	29.12	30.88	34.75	37.25

SWITCH EASEMENT S 3–100. GAGE, 5 FT. 2½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail X	Inner Rail Y	S°	Length Outer	Length Inner	Correction for T Rail	
	102⅓	6°–30′	0.641	11.289	6°–30′	11.904	11.314	.010	This Easement gives an O G equal to and a G S 4.391 less than Spiral No. 3.
4	81	8°–30′	1.328	16.028	10°–00′	17.012	16.102	.016	
5	60	5°–00′	2.412	20.917	15°–00′	22.475	21.111	.024	
6	50	6°–00′	3.945	25.635	21°–00′	27.983	26.075	.033	
7	40	7°–00′	5.838	29.790	28°–00′	33.189	30.643	.044	

SWITCH EASEMENT S 3–200. GAGE, 5 FT. 2½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail X	Inner Rail Y	S°	Length Outer	Length Inner	Correction for T Rail	
	200	4°–00′	0.481	13.769	4°–00′	14.145	13.781	.006	This Easement gives an O G 0.250 greater and a G S 2.853 greater than Spiral No. 3.
3	132	2°–00′	0.875	18.269	6°–00′	18.843	18.297	.009	
4	75	4°–00′	1.578	23.272	10°–00′	24.261	23.351	.016	
5	60	5°–00′	2.662	28.161	15°–00′	29.724	28.360	.024	
6	50	6°–00′	4.195	32.879	21°–00′	35.232	33.324	.033	
7	40	7°–00′	6.088	37.034	28°–00′	40.438	37.892	.044	

SPIRAL No. 4. GAGE, 5 FT. 2½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	420	0°-42′	0.031	5.099	0°-42′	.00007	.01222	5.163	5.099	.001
2	210	1°-24′	0.155	10.166	2°-06′	.00067	.03664	10.358	10.168	.003
3	140	2°-06′	0.432	15.193	4°-12′	.00269	.07324	15.585	15.203	.007
4	105	2°-48′	0.920	20.173	7°-00′	.00745	.12187	20.843	20.207	.011
5	84	3°-30′	1.676	25.086	10°-30′	.01675	.18224	26.133	25.179	.016
6	70	4°-12′	2.754	29.906	14°-42′	.03273	.25376	31.456	30.120	.023
7	60	4°-54′	4.201	34.595	19°-36′	.05794	.33545	36.810	35.028	.031
	52½									

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
0.99	1.01	6.94	7.06	12.85	13.15	18.72	19.28	24.54	25.46	30.32	31.68
1.99	2.01	7.93	8.07	13.84	14.16	19.69	20.31	25.51	26.49	31.28	32.72
2.98	3.02	8.92	9.08	14.82	15.18	20.67	21.33	26.47	27.53	32.24	33.76
3.98	4.02	9.91	10.09	15.79	16.21	21.64	22.36	27.44	28.56	33.19	34.81
4.97	5.03	10.89	11.11	16.77	17.23	22.61	23.39	28.40	29.60	34.15	35.85
5.96	6.04	11.87	12.13	17.74	18.26	23.57	24.43	29.36	30.64		

SWITCH EASEMENT S 4–200. GAGE, 5 FT. 2½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Length Outer	Length Inner	Correction for T Rail
			X	Y				
	200	4°–00′	0.481	13.769	4°–00′	14.145	13.781	.006
4	125½	3°–00′	1.098	20.173	7°–00′	20.852	20.216	.011
5	84	3°–30′	1.854	25.086	10°–30′	26.142	25.188	.016
6	70	4°–12′	2.932	29.906	14°–42′	31.464	30.128	.023
7	60	4°–54′	4.379	34.595	19°–36′	36.819	35.037	.031

This Easement gives an O G 0.178 greater and a G S equal to Spiral No. 4.

SPIRAL No. 5. GAGE, 5 FT. 2½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	600	0°-30′	0.023	5.213	0°-30′	.00004	.00873	5.259	5.218	.001
2	300	1°-00′	0.113	10.403	1°-30′	.00034	.02618	10.540	10.404	.002
3	200	1°-30′	0.316	15.567	3°-00′	.00137	.05234	15.844	15.572	.005
4	150	2°-00′	0.675	20.699	5°-00′	.00381	.08716	21.171	20.717	.008
5	120	2°-30′	1.233	25.790	7°-30′	.00856	.13053	26.521	25.839	.012
6	100	3°-00′	2.029	30.828	10°-30′	.01675	.18224	31.893	30.939	.016
7	85	3°-30′	3.098	35.744	14°-00′	.02970	.24192	37.244	35.972	.022
	75									

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
1.00	1.00	6.96	7.04	12.90	13.10	18.81	19.19	24.69	25.31	30.53	31.47
1.99	2.01	7.95	8.05	13.89	14.11	19.79	20.21	25.66	26.34	31.50	32.50
2.99	3.01	8.94	9.06	14.87	15.13	20.77	21.23	26.64	27.36	32.47	33.53
3.98	4.02	9.94	10.06	15.86	16.14	21.75	22.25	27.61	28.39	33.44	34.56
4.98	5.02	10.93	11.07	16.84	17.16	22.73	23.27	28.59	29.41	34.41	35.59
5.97	6.03	11.91	12.09	17.82	18.18	23.71	24.29	29.56	30.44	35.38	36.62

SWITCH EASEMENT S 5–200. GAGE, 5 FT. 2½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Length Outer	Length Inner	Correction for T Rail	
			X	Y					
	200	4°–00′	0.481	13.769	4°–00′	14.145	13.781	.006	This Easement gives an O G equal to and a G S 4.468 less than Spiral No. 5.
4	144	11°–00′	0.675	16.231	5°–00′	16.703	16.249	.008	
5	120	2°–30′	1.233	21.322	7°–30′	22.053	21.371	.012	
6	100	3°–00′	2.029	26.360	10°–30′	27.425	26.471	.016	
7	85	3°–30′	3.098	31.276	14°–00′	32.776	31.504	.022	

SPIRAL No. 6. GAGE, 5 FT. 2½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	900	0°-20′	0.015	5.221	0°-20′	.00002	.00582	5.251	5.221	.001
2	450	0°-40′	0.076	10.427	1°-00′	.00015	.01745	10.517	10.427	.002
3	300	1°-00′	0.211	15.615	2°-00′	.00061	.03490	15.799	15.617	.003
4	225	1°-20′	0.453	20.785	3°-20′	.00169	.05814	21.096	20.792	.005
5	180	1°-40′	0.827	25.931	5°-00′	.00381	.08716	26.407	25.953	.008
6	150	2°-00′	1.366	31.048	7°-00′	.00745	.12187	31.734	31.098	.011
7	128	2°-20′	2.091	36.102	9°-20′	.01324	.16218	37.054	36.204	.015
	112½									

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
1.00	1.00	6.98	7.02	12.93	13.07	18.87	19.13	24.79	25.21	30.69	31.31
1.99	2.01	7.97	8.03	13.92	14.08	19.86	20.14	25.77	26.23	31.67	32.33
2.99	3.01	8.96	9.04	14.92	15.08	20.85	21.15	26.76	27.24	32.65	33.35
3.99	4.01	9.96	10.04	15.91	16.09	21.83	22.17	27.74	28.26	33.63	34.37
4.99	5.01	10.95	11.05	16.89	17.11	22.82	23.18	28.72	29.28	34.61	35.39
5.98	6.02	11.94	12.06	17.88	18.12	23.80	24.20	29.71	30.29	35.59	36.41

SWITCH EASEMENT S 6–200. GAGE, 5 FT. 2½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Length Outer	Length Inner	Correction for T Rail	
			X	Y					
	200	4°–00′	0.481	13.769	4°–00′	14.145	13.781	.006	This Easement gives an O G equal to and a G S 7.770 less than Spiral No. 6.
5	255	1°–00′	0.827	18.161	5°–00′	18.640	18.186	.008	
6	150	2°–00′	1.366	23.278	7°–00′	23.967	23.331	.011	
7	128	2°–20′	2.091	28.332	9°–20′	29.286	28.438	.015	

SPIRAL No. 2. GAGE, 5 FT. 4½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	300	0°–30′	0.011	2.595	0°–30′	.00004	.00873	2.641	2.595	.001
2	150	1°–00′	0.056	5.165	1°–30′	.00034	.02618	5.306	5.166	.002
3	100	1°–30′	0.156	7.710	3°–00′	.00137	.05234	7.995	7.713	.005
4	75	2°–00′	0.332	10.229	5°–00′	.00381	.08716	10.707	10.237	.008
5	60	2°–30′	0.604	12.714	7°–30′	.00856	.13053	13.442	12.738	.012
6	50	3°–00′	0.991	15.161	10°–30′	.01675	.18224	16.201	15.215	.016
7	42½	3°–30′	1.507	17.537	14°–00′	.02970	.24192	18.961	17.647	.022
8	37½	4°–00′	2.177	19.873	18°–00′	.04894	.30902	21.766	20.078	.028
	33⅓									

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
.99	1.01	5.91	6.09	10.74	11.26	15.49	16.51
1.98	2.02	6.88	7.12	11.70	12.30	16.42	17.58
2.97	3.03	7.85	8.15	12.65	13.35	17.36	18.64
3.95	4.05	8.82	9.18	13.60	14.40	18.29	19.71
4.93	5.07	9.78	10.22	14.55	15.45	19.22	20.78

SWITCH EASEMENT S 2–75. GAGE, 5 FT. 4½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Length Outer	Length Inner	Correction for T Rail	
			X	Y					
	75	7°–50′	.675	9.856	7°–50′	10.621	9.887	.012	This Easement gives an O G equal to and a G S 3.346 less than Spiral No. 2.
6	45⅓	2°–40′	.991	11.815	10°–30′	12.857	11.871	.016	
7	42½	3°–30′	1.507	14.191	14°–00′	15.617	14.303	.022	
8	37½	4°–00′	2.177	16.526	18°–00′	18.422	16.734	.028	

SPIRAL No. 2½. GAGE, 5 FT. 4½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	444	0°-20′	.007	2.567	0°-20′	.00002	.00582	2.599	2.567	0.000
2	222	0°-40′	.038	5.119	1°-00′	.00015	.01745	5.213	5.119	0.002
3	148	1°-00′	0.103	7.655	2°-00′	.00061	.03490	7.843	7.655	0.003
4	111	1°-20′	0.221	10.172	3°-20′	.00169	.05814	10.488	10.176	0.005
5	89	1°-40′	0.404	12.676	5°-00′	.00381	.08716	13.156	12.686	0.008
6	74	2°-00′	0.664	15.150	7°-00′	.00745	.12187	15.882	15.176	0.011
7	63½	2°-20′	1.015	17.602	9°-20′	.01324	.16218	18.528	17.652	0.015
8	55½	2°-40′	1.470	20.017	12°-00′	.02185	.20791	21.236	20.110	0.019
9	49	3°-00′	2.036	22.374	15°-00′	.03407	.25882	23.943	22.535	0.024
10	44½	3°-20′	2.734	24.705	18°-20′	.05076	.31454	26.688	24.968	0.029
11	40½	3°-40′	3.567	26.976	22°-00′	.07282	.37461	29.452	27.388	0.035

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
.99	1.01	5.94	6.06	10.82	11.18	15.65	16.35	20.42	21.58	25.13	26.87
1.99	2.01	6.92	7.08	11.79	12.21	16.61	17.39	21.36	22.64	26.06	27.91
2.98	3.02	7.90	8.10	12.76	13.24	17.57	18.43	22.31	23.69	27.00	29.00
3.97	4.03	8.88	9.12	13.73	14.27	18.52	19.48	23.25	24.75		
4.96	5.04	9.85	10.15	14.69	15.31	19.47	20.53	24.19	25.81		

SWITCH EASEMENT S 2½–100. GAGE, 5 FT. 4½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail X	Inner Rail Y	S°	Length Outer	Length Inner	Correction for T Rail	
	102⅓	6°-30′	0.641	11.280	6°-30′	11.914	11.304	.010	This Easement gives an O G equal to and a G S 3.640 less than Spiral No. 2½.
8	56½	5°-30′	1.470	16.377	12°-00′	17.596	16.470	.019	
9	49	3°-00′	2.036	18.734	15°-00′	20.308	18.895	.024	
10	44½	3°-20′	2.734	21.065	18°-20′	23.047	21.327	.029	
11	40⅝	3°-40′	3.567	23.336	22°-00′	25.811	23.747	.035	

SWITCH EASEMENT S 2½–200. GAGE, 5 FT. 4½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail X	Inner Rail Y	S°	Length Outer	Length Inner	Correction for T Rail	
	200	4°-00′	0.480	13.763	4°-00′	14.151	13.775	.006	This Easement gives an O G 0.250 greater and a G S 3.286 greater than Spiral No. 2½.
5	129	1°-00′	0.654	15.962	5°-00′	16.449	15.979	.008	
6	74	2°-00′	0.914	18.436	7°-00′	19.125	18.469	.011	
7	63½	2°-20′	1.265	20.888	9°-20′	21.821	20.945	.014	
8	55½	2°-40′	1.720	23.308	12°-00′	24.529	23.408	.019	
9	49	3°-00′	2.286	25.660	15°-00′	27.236	25.828	.024	
10	44½	3°-20′	2.984	27.991	18°-20′	28.981	28.261	.029	
11	40½	3°-40′	3.817	30.262	22°-00′	32.745	30.681	.035	

SPIRAL No. 3. GAGE, 5 FT. 4½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	300	1°–0′	0.046	5.189	1°–0′	.00015	.01745	5.283	5.189	.002
2	150	2°–0′	0.225	10.327	3°–0′	.00137	.05234	10.613	10.331	.005
3	100	3°–0′	0.624	15.407	6°–0′	.00548	.10453	15.989	15.427	.009
4	75	4°–0′	1.327	20.404	10°–0′	.01519	.17365	21.413	20.475	.016
5	60	5°–0′	2.409	25.286	15°–0′	.03407	.25882	26.884	25.476	.024
6	50	6°–0′	3.939	29.996	21°–0′	.06642	.35837	32.401	30.431	.033
7	40	7°–0′	5.828	34.141	28°–0′	.11705	.46947	37.616	34.990	.044
	35									

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
.99	1.01	6.92	7.08	12.79	13.21	18.60	19.40	24.35	25.65	30.04	31.96
1.98	2.02	7.90	8.10	13.76	14.24	19.57	20.43	25.30	26.70	30.98	33.02
2.97	3.03	8.89	9.11	14.74	15.26	20.53	21.47	26.25	27.75	31.91	34.09
3.96	4.04	9.87	10.13	15.71	16.29	21.48	22.52	27.20	28.80	32.84	35.16
4.96	5.04	10.85	11.15	16.67	17.33	22.44	23.56	28.14	29.86	33.77	36.23
5.94	6.06	11.82	12.18	17.64	18.36	23.39	24.61	29.09	30.91	34.71	37.29

SWITCH EASEMENT S 3–100. GAGE, 5 FT. 4½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail X	Inner Rail Y	S°	Length Outer	Length Inner	Correction for T Rail	
	102⅓	6°–30′	0.641	11.280	6°–30′	11.914	11.304	.010	This Easement gives an O G equal to and a G S 4.391 less than Spiral No. 3.
4	81	3°–30′	1.327	16.013	10°–00′	17.026	16.088	.016	
5	60	5°–00′	2.409	20.895	15°–00′	22.497	21.089	.024	
6	50	6°–00′	3.939	25.605	21°–00′	28.014	26.044	.033	
7	40	7°–00′	5.828	29.750	28°–00′	33.230	30.602	.044	

SWITCH EASEMENT S 3–200. GAGE, 5 FT. 4½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail X	Inner Rail Y	S°	Length Outer	Length Inner	Correction for T Rail	
	200	4°–00′	0.480	13.763	4°–00′	14.151	13.775	.006	This Easement gives an O G 0.250 greater and a G S 2.853 greater than Spiral No. 3.
3	132	2°–00′	0.874	18.260	6°–00′	18.851	18.289	.009	
4	75	4°–00′	1.577	23.257	10°–00′	24.275	23.337	.016	
5	60	5°–00′	2.659	28.139	15°–00′	29.746	28.338	.024	
6	50	6°–00′	4.189	32.849	21°–00′	35.263	33.293	.033	
7	40	7°–00′	6.078	36.994	28°–00′	40.478	37.852	.044	

SPIRAL No. 4. GAGE, 5 FT. 4½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	420	0°-42′	0.081	5.098	0°-42′	.00007	.01222	5.164	5.098	.001
2	210	1°-24′	0.155	10.163	2°-05′	.00067	.03664	10.362	10.164	.003
3	140	2°-06′	0.432	15.187	4°-12′	.00269	.07324	15.591	15.197	.007
4	105	2°-48′	0.919	20.162	7°-00′	.00745	.12187	20.854	20.196	.011
5	84	3°-30′	1.675	25.071	10°-30′	.01675	.18224	26.149	25.163	.016
6	70	4°-12′	2.751	29.885	14°-42′	.03273	.25376	31.478	30.098	.023
7	60	4°-54′	4.196	34.567	19°-36′	.05794	.33545	36.888	35.000	.031
	52½									

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
0.99	1.01	6.94	7.06	12.85	13.15	18.71	19.29	24.53	25.47	30.30	31.70
1.99	2.01	7.93	8.07	13.83	14.17	19.68	20.32	25.49	26.51	31.26	32.74
2.98	3.02	8.92	9.08	14.81	15.19	20.66	21.34	26.46	27.54	32.21	33.79
3.97	4.03	9.90	10.10	15.79	16.21	21.62	22.38	27.42	28.58	33.16	34.84
4.97	5.03	10.89	11.11	16.76	17.24	22.59	23.41	28.38	29.62	34.12	35.88
5.96	6.04	11.87	12.13	17.74	18.26	23.56	24.44	29.34	30.66		

SWITCH EASEMENT S 4–200. GAGE, 5 FT. 4½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Length Outer	Length Inner	Correction for T Rail	
			X	Y					
	200	4°–00′	0.480	13.763	4°–00′	14.151	13.775	.006	This Easement gives an O G 0.178 greater and a G S equal to Spiral No. 4.
4	125½	3°–00′	1.097	20.162	7°–00′	20.862	20.206	.011	
5	84	3°–30′	1.853	25.071	10°–30′	26.158	25.172	.016	
6	70	4°–12′	2.929	29.885	14°–42′	31.486	30.106	.023	
7	60	4°–54′	4.374	34.567	19°–36′	36.847	35.009	.031	

SPIRAL NO. 5. GAGE, 5 FT. 4½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	600	0°-30′	.023	5.213	0°-30′	.00004	.00873	5.259	5.213	.001
2	300	1°-00′	.113	10.401	1°-30′	.00034	.02618	10.542	10.402	.002
3	200	1°-30′	.316	15.562	3°-00′	.00137	.05234	15.849	15.567	.005
4	150	2°-00′	.675	20.692	5°-00′	.00381	.08716	21.179	20.709	.008
5	120	2°-30′	1.232	25.779	7°-30′	.00856	.13053	26.532	25.828	.012
6	100	3°-00′	2.028	30.812	10°-30′	.01675	.18224	31.908	30.924	.016
7	85	3°-30′	3.095	35.724	14°-00′	.02970	.24192	37.265	35.951	.022
	75									

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
1.00	1.00	6.96	7.04	12.90	13.10	18.80	19.20	24.68	25.32	30.52	31.48
1.99	2.01	7.95	8.05	13.88	14.12	19.78	20.22	25.65	26.35	31.49	32.51
2.99	3.01	8.94	9.06	14.87	15.13	20.76	21.24	26.63	27.37	32.46	33.54
3.98	4.02	9.93	10.07	15.85	16.15	21.74	22.26	27.60	28.40	33.43	34.57
4.98	5.02	10.92	11.08	16.84	17.16	22.72	23.28	28.57	29.43	34.40	35.60
5.97	6.03	11.91	12.09	17.82	18.18	23.70	24.30	29.55	30.45	35.36	36.64

SWITCH EASEMENT S 5–200. GAGE, 5 FT. 4½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Length Outer	Length Inner	Correction for T Rail	
			X	Y					
	200	4°–00′	0.480	13.763	4°–00′	14.151	13.775	.006	This Easement gives an O G equal to and a G S 4.468 less than Spiral No. 5.
4	144	1°–00′	0.675	16.224	5°–00′	16.711	16.241	.008	
5	120	2°–30′	1.232	21.311	7°–30′	22.064	21.360	.012	
6	100	3°–00′	2.028	26.344	10°–30′	27.441	26.455	.016	
7	85	3°–30′	3.095	31.256	14°–00′	32.797	31.483	.022	

SPIRAL No. 6. GAGE, 5 FT. 4½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Versine	Sine	Length Outer	Length Inner	Correction for T Rail
			X	Y						
1	900	0°-20′	0.015	5.220	0°-20′	.00002	.00582	5.252	5.220	.001
2	450	0°-40′	0.076	10.425	1°-00′	.00015	.01745	10.519	10.425	.002
3	300	1°-00′	0.211	15.612	2°-00′	.00061	.03490	15.802	15.614	.003
4	225	1°-20′	0.452	20.780	3°-20′	.00169	.05814	21.100	20.788	.005
5	180	1°-40′	0.827	25.924	5°-00′	.00381	.08716	26.415	25.945	.008
6	150	2°-00′	1.365	31.037	7°-00′	.00745	.12187	31.744	31.088	.011
7	128	2°-20′	2.089	36.089	9°-20′	.01324	.16218	37.067	36.191	.015
	112½									

TIE ROD DISTANCES FROM P. S.

Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail	Inner Rail	Outer Rail
1.00	1.00	6.97	7.03	12.93	13.07	18.87	19.13	24.78	25.22	30.68	31.32
1.99	2.01	7.97	8.03	13.92	14.08	19.86	20.14	25.77	26.23	31.66	32.34
2.99	3.01	8.96	9.04	14.91	15.09	20.84	21.16	26.75	27.25	32.64	33.36
3.99	4.01	9.96	10.04	15.90	16.10	21.83	22.17	27.73	28.27	33.62	34.38
4.99	5.01	10.95	11.05	16.89	17.11	22.81	23.19	28.71	29.29	34.60	35.40
5.98	6.02	11.94	12.06	17.88	18.12	23.80	24.20	29.70	30.30	35.58	36.42

SWITCH EASEMENT S 6–200. GAGE, 5 FT. 4½ IN.

Point No.	Cent. Rad.	Angle	Inner Rail		S°	Length Outer	Length Inner	Correction for T Rail	
			X	Y					
	200	4°–00′	0.480	13.763	4°–00′	14.151	13.775	.006	This Easement gives an O G equal to and a G S 7.770 less than Spiral No. 6.
5	255	1°–00′	0.827	18.154	5°–00′	18.648	18.178	.008	
6	150	2°–00′	1.365	23.267	7°–00′	23.977	23.321	.011	
7	128	2°–20′	2.089	28.319	9°–20′	29.300	28.424	.015	

Middle Ordinates for 10-Foot Chords.

MIDDLE ORDINATES, 10 FT. CHORDS

M. O.	Radius	M. O.	Radius	M. O.	Radius
0 ″	infinity	1″	150′– 0½″	2″	75′– 1″
1/32″	4807′– 8″	1 1/32″	145′– 6″	2 1/32″	73′–11 3/16″
1/16″	2399′– 3″	1 1/16″	141′– 2 11/16″	2 1/16″	72′– 9¾″
3/32″	1600′– 6″	1 3/32″	137′– 2⅜″	2 3/32″	71′– 8¾″
⅛″	1200′– 9″	1⅛″	133′– 4¾″	2⅛″	70′– 8⅛″
5/32″	960′– 1″	1 5/32″	129′– 9 5/16″	2 5/32″	69′– 7⅞″
3/16″	800′– 3 3/16″	1 3/16″	126′– 4⅜″	2 3/16″	68′– 7 15/16″
7/32″	682′– 3 3/16″	1 7/32″	123′– 2⅜″	2 7/32″	67′– 8 3/16″
¼″	600′– 0⅛″	1¼″	120′– 0⅝″	2¼″	66′– 9⅛″
9/32″	533′– 4⅛″	1 9/32″	117′– 1½″	2 9/32″	65′–10 3/16″
5/16″	480′– 0 3/16″	1 5/16″	114′– 4⅛″	2 5/16″	64′–11 9/16″
11/32″	436′– 4 9/16″	1 11/32″	111′– 8 3/16″	2 11/32″	64′– 1 3/16″
⅜″	400′– 0 3/16″	1⅜″	109′– 1¾″	2⅜″	63′– 3 1/16″
13/32″	369′– 3″	1 13/32″	106′– 8 11/16″	2 13/32″	62′– 5¼″
7/16″	342′–10 5/16″	1 7/16″	104′– 4 15/16″	2 7/16″	61′– 7 11/16″
15/32″	320′– 0½″	1 15/32″	102′– 2¼″	2 15/32″	60′–10 5/16″
½″	300′– 0¼″	1½″	100′– 0¾″	2½″	60′– 1¼″
17/32″	282′– 4 9/16″	1 17/32″	98′– 0¼″	2 17/32″	59′– 4⅜″
9/16″	266′– 8 1/16″	1 9/16″	96′– 0¾″	2 9/16″	58′– 7¾″
19/32″	253′– 0 15/16″	1 19/32″	94′– 2 3/16″	2 19/32″	57′–11¼″
5/8″	240′– 0 7/16″	1⅝″	92′– 4½″	2⅝″	57′– 3″
21/32″	228′– 7 1/16″	1 21/32″	90′– 7 1/16″	2 21/32″	56′– 7″
11/16″	218′– 1 15/16″	1 11/16″	88′–11½″	2 11/16″	55′–11⅛″
23/32″	209′– 1 15/16″	1 23/32″	87′– 4⅛″	2 23/32″	55′– 3 7/16″
¾″	200′– 2 9/16″	1¾″	85′– 9 7/16″	2¾″	54′– 7 15/16″
25/32″	192′– 0⅜″	1 25/32″	84′– 3 7/16″	2 25/32″	54′– 0 9/16″
13/16″	184′– 7¾″	1 13/16″	82′–10″	2 13/16″	53′– 5 7/16″
27/32″	177′– 9 11/16″	1 27/32″	81′– 5¼″	2 27/32″	52′–10 3/8″
⅞″	171′– 5½″	1⅞″	80′– 0 15/16″	2⅞″	52′– 3½″
29/32″	165′– 6 5/8″	1 29/32″	78′– 9¼″	2 29/32″	51′– 8 13/16″
15/16″	160′– 0½″	1 15/16″	77′– 6″	2 15/16″	51′– 2¼″
31/32″	154′–10½″	1 31/32″	76′– 3¼″	2 31/32″	50′– 7 15/16″

MIDDLE ORDINATES, 10 FT. CHORDS

M. O.	Radius	M. O.	Radius	M. O.	Radius
3″	50′– 1½″	4″	37′– 8″	5″	30′– 2½″
3 1/32″	49′– 7 15/16″	4 1/32″	37′– 4½″	5 1/32″	30′– 0¼″
3 1/16″	49′– 1¼″	4 1/16″	37′– 1 1/8″	5 1/16″	29′–10 1/16″
3 3/32″	48′– 7⅜″	4 3/32″	36′– 9¾″	5 3/32″	29′– 7 15/16″
3⅛″	48′– 1 9/16″	4⅛″	36′– 6 7/16″	5⅛″	29′– 5 13/16″
3 5/32″	47′– 7⅞″	4 5/32″	36′– 3 3/16″	5 5/32″	29′– 3 11/16″
3 3/16″	47′– 2 5/16″	4 3/16″	35′–11 5/16″	5 3/16″	29′– 1 7/16″
3 7/32″	46′– 8 13/16″	4 7/32″	35′– 8¾″	5 7/32″	28′–11½″
3¼″	46′– 3½″	4¼″	35′– 5 11/16″	5¼″	28′– 9½″
3 9/32″	45′–10 3/16″	4 9/32″	35′– 2 9/16″	5 9/32″	28′– 7½″
3 5/16″	45′– 5 1/16″	4 5/16″	34′–11 9/16″	5 5/16″	28′– 5½″
3 11/32″	45′– 0″	4 11/32″	34′– 8 9/16″	5 11/32″	28′– 3½″
3⅜″	44′– 7″	4⅜″	34′– 5⅝″	5⅜″	28′– 1 9/16″
3 13/32″	44′– 2⅛″	4 13/32″	34′– 2 11/16″	5 13/32″	27′–11 5/8″
3 7/16″	43′– 9⅜″	4 7/16″	33′–11⅞″	5 7/16″	27′– 9¾″
3 15/32″	43′– 4 11/16″	4 15/32″	33′– 9 1/16″	5 15/32″	27′– 7⅞″
3½″	43′– 0 1/16″	4½″	33′– 6¼″	5½″	27′– 6″
3 17/32″	42′– 7½″	4 17/32″	33′– 3½″	5 17/32″	27′– 4 3/16″
3 9/16″	42′– 3 1/16″	4 9/16″	33′– 0 13/16″	5 9/16″	27′– 2⅜″
3 19/32″	41′–10 11/16″	4 19/32″	32′–10⅞″	5 19/32″	27′– 0 9/16″
3⅝″	41′– 6⅜″	4⅝″	32′– 7½″	5⅝″	26′–10 13/16″
3 21/32″	41′– 2⅛″	4 21/32″	32′– 4⅞″	5 21/32″	26′– 9 1/16″
3 11/16″	40′–10″	4 11/16″	32′– 2⅜″	5 11/16″	26′– 7 1/16″
3 23/32″	40′– 5⅞″	4 23/32″	31′–11 13/16″	5 23/32″	26′– 5 9/16″
3¾″	40′– 1⅞″	4¾″	31′– 9 5/16″	5¾″	26′– 3 15/16″
3 25/32″	39′– 9 15/16″	4 25/32″	31′– 6⅞″	5 25/32″	26′– 2¼″
3 13/16″	39′– 6 1/16″	4 13/16″	31′– 4⅜″	5 13/16″	26′– 0 9/16″
3 27/32″	39′– 2⅛″	4 27/32″	31′– 2 1/16″	5 27/32″	25′–10 15/16″
3⅞″	38′–10 7/16″	4⅞″	30′–11 5/8″	5⅞″	25′– 9 5/16″
3 29/32″	38′– 6¾″	4 29/32″	30′– 9 5/16″	5 29/32″	25′– 7 11/16″
3 15/16″	38′– 3⅛″	4 15/16″	30′– 7″	5 15/16″	25′– 6⅛″
3 31/32″	37′–11½″	4 31/32″	30′– 4¾″	5 31/32″	25′– 4 9/16″

Wheel Contours

A GREAT variety of wheel contours are used on street railways, and often the extremes are used on the same track system to the great detriment of both special work and wheels.

Since there are now no standard wheel contours except the M. C. B. (steam railroad), it seems proper to offer some designs which will meet most of the difficulties found in our practice.

The contour of wheel fixes the character of the special work as to whether the frog work is to be "flange bearing." This term means that at the "waist of frog," i. e., just in advance of the point of frog, the floor of the throat is raised to carry the wheel through the waist and past the point upon its flange. The latter cannot be of a shape or character of metal well adapted to this service, and more or less chipped flanges are thereby caused. It is, however, inevitable that this support be provided,

unless the tread is wide enough to carry the wheel past this critical point.

Contour "A" is the M. C. B. standard wheel, and is adapted to open track and streets where rails with deep and wide flangeways are provided, and the paving is such that the tread will not be seriously chipped by contact with the same.

Contour "B" is a compromise wheel, for use where a portion of the track system is used by wheels having Contour "A" and the remainder has not the deep flangeway, but the width of flangeway is provided. If the paving conditions of this portion are such that the width of tread must be reduced from that shown, all frog work on the entire portion of system used by Contour "B" must be made "flange bearing."

Contour "C" is adapted to track systems where wide and deep flangeways cannot be provided but the paving conditions are such that the width of the tread shown can be used.

Contour "D" is adapted to track systems where a narrower tread is required by

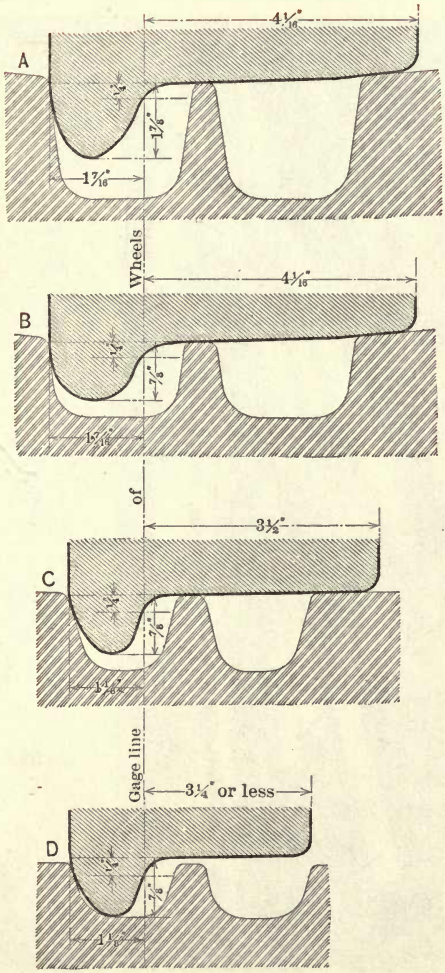
the paving conditions, the shape and size of flange being the same as "C." As wide a tread as possible should be used, as the life of special work will thereby be materially prolonged besides increasing the factor of safety on any open track in the system. "Flange-bearing" frogs will be required for this contour.

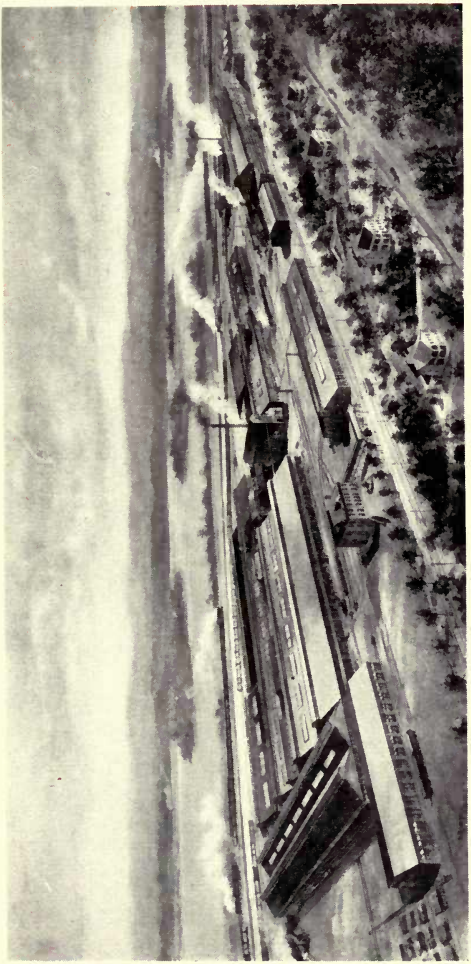
Contours "A" and "C" will give the best results where conditions permit their use and do not require "flange-bearing" frogs.

Contour "B" will not give entire satisfaction, since the flange is not of the best shape, and should only be used when compelled by the conditions stated.

Contours "C" and "D" can be used on the same track system if "flange-bearing" frogs are provided for that portion on which Contour "D" is used.

Contours "C" and "D" cannot be satisfactorily used on track systems designed for Contours "A" or "B," or vice versa.


A
4 1/16"
1"
1 7/16"
1 7/16"
Wheels
B
4 1/16"
1"
1 7/16"
1 7/16"
of
C
3 1/2"
1"
1 7/16"
1 7/16"
Gage line
D
3 1/4" or less
1"
1 7/16"
1 1/16"



FROG AND SWITCH DEPARTMENT OF THE PENNSYLVANIA STEEL COMPANY, STEELTON, PA.

Angles

Bulb
Reinforcing
Switch
Equal Legs
Unequal Legs

Braces

Acme
Switch
Guard
Interlocking
Tie Plate

Bridges

Buildings

Chairs

Rail chairs for steam railroads in paved streets

Channels

Circles

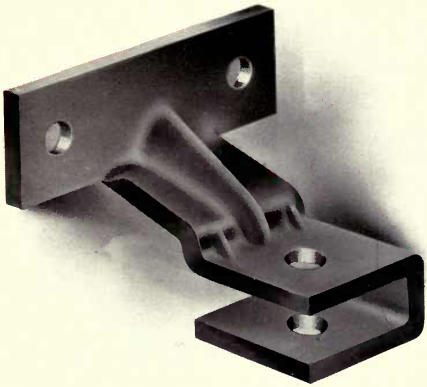
Turntables
Coal storage tracks

Clamps

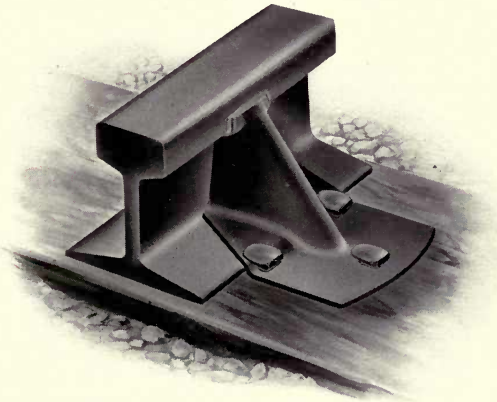
Guard rail

Crossings

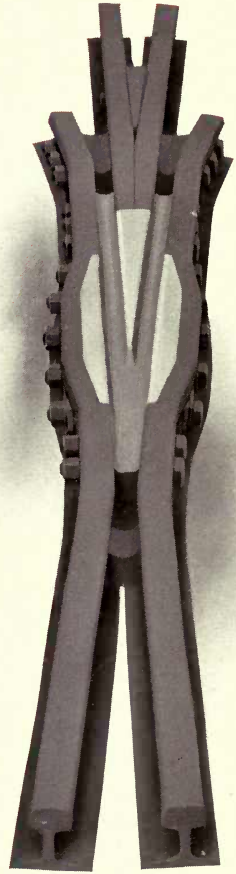
Bolted
Bolted Plate
Keyed
"Manard" Steel
Movable Point
Riveted
Street Railway
"Manard" Renewable Centre
Double Slip
Single Slip
Three Rail



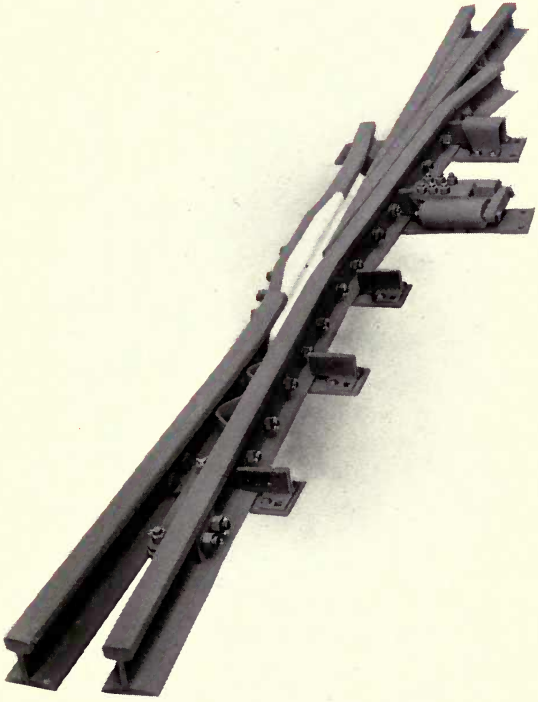
DROP FORGED SOCKET



ACME BRACE



MANARD ANVIL FACE FROG, DESIGN 153



MANARD ANVIL FACE SPRING RAIL FROG

Crossovers

Single Crossovers
Double Crossovers
Portable Crossovers

Forgings

Frogs, Rigid

Bolted
Bolted Plate
Keyed
"Manard" Steel
"Manard" Renewable Centre
Riveted

Frogs, Spring

Bolted
Bolted Plate
Double
Hinged
Keyed
"Manard" Steel
Riveted Plate
Twin
Vaughan Hinged
Vaughan Sliding

Joints

Angle
Channel
Compromise
Deep Girder Rail
Plain

Knees

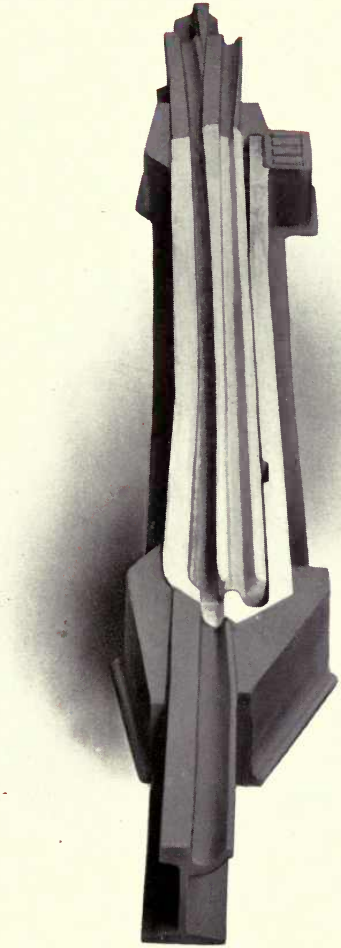
Mates

Built
"Manard" Bolted
"Manard" Key Fast

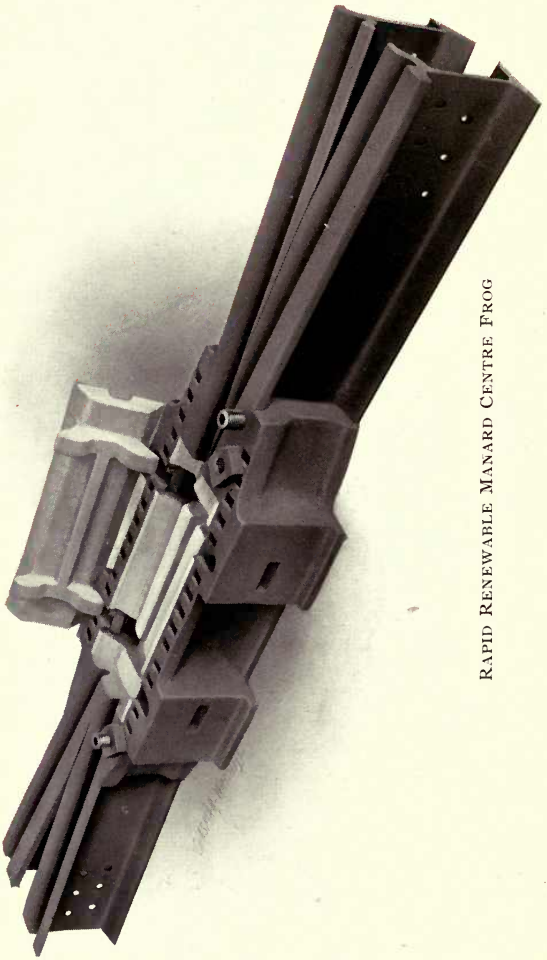
Plates

Frog
Slide
Switch
Tie

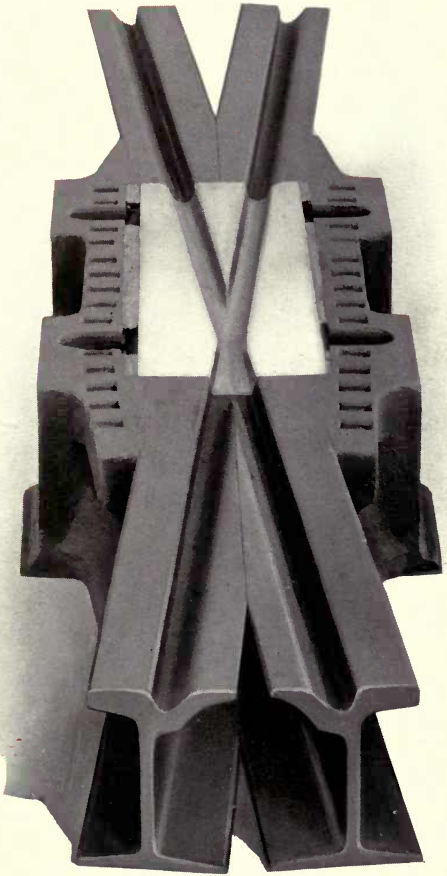
Rails, Guard



MANARD GROOVED TONGUE SWITCH FOR STEAM RAILROADS IN PAVED STREETS



RAPID RENEWABLE MANARD CENTRE FROG



RAPID RENEWABLE MANARD CENTRE FROG

Rails

A. S. C. E. Sections
Cast Weld Compromise
Check
Flat
Girder
Girder Guard
Slot Rails and Conductor Bars
Tee
High Tee
Tram

Rails, Renewable Guard

Rods, Switch Connecting

Splice Bars

Spikes

Spiral Curves

Steam Railroad Track Equipment

Street Railway Special Work

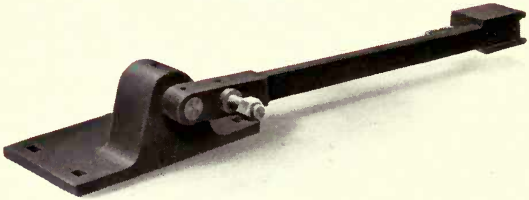
Street Railway Track Fastenings

Steel

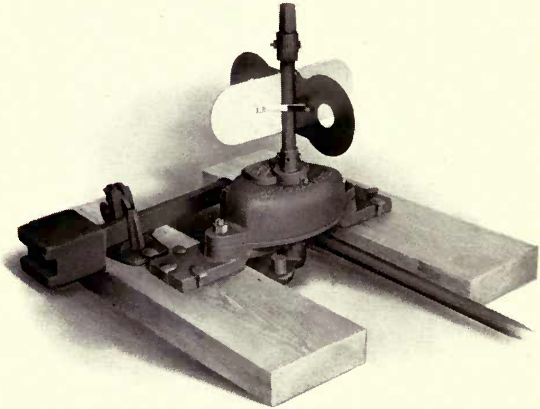
Bessemer
Billets
Blooms
Castings
Forgings
Flats
Basic Open Hearth
Acid Open Hearth
"Manard"
Merchant
Round
Shapes
Slabs
Special
Square
Tool

Structural Steel

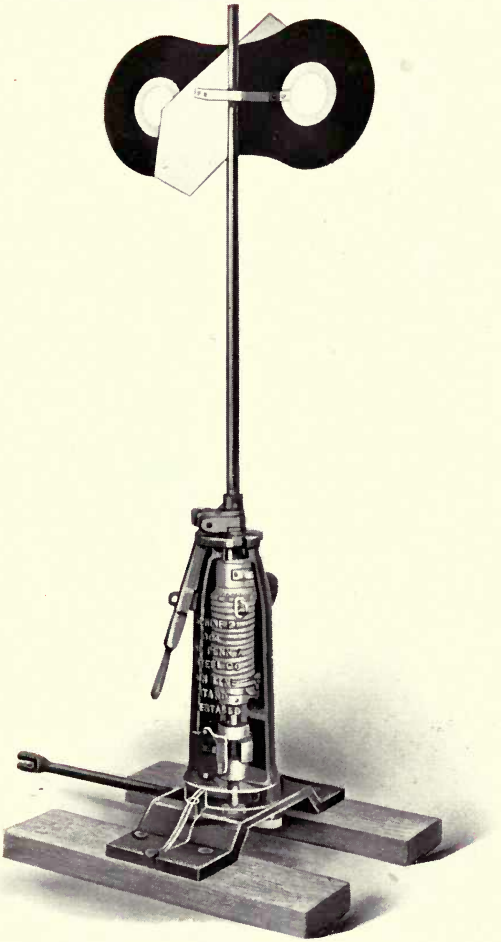
STANDARD MANARD BIG PIN SWITCH



GROUND LEVER, MODEL 16



LOW NEW CENTURY ADJUSTABLE SWITCH STAND
MODEL 51 A



INTERMEDIATE MAIN LINE SWITCH STAND
MODEL 47 B

Switches

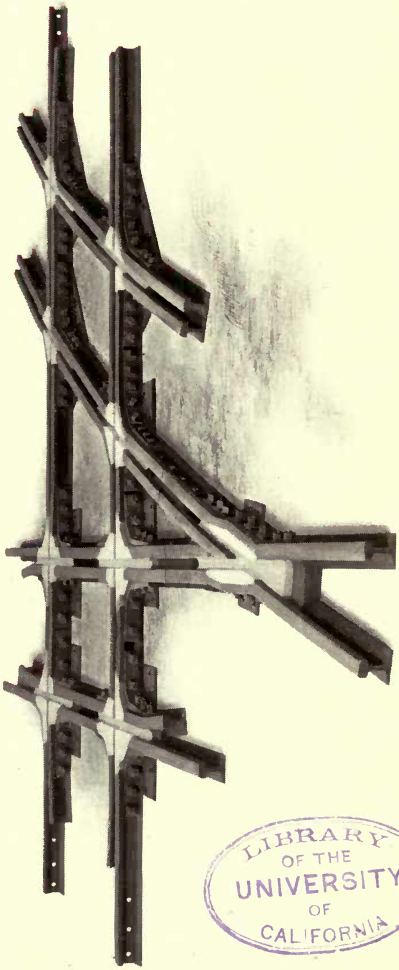
Adjustable
Angle
Challenge
Lorenz
"Manard" Big Pin Grooved Tongue
"Manard" Big Pin Tongue
"Manard" Steel
Plain
Reinforced
Socket
Stub
Three Way

Switch Stands

Automatic
Banner
Steelton Detective
Ground Levers
Upright Levers
Long Safety
Main Line Adjustable
Positive
Automatic
Mine
Mine Kickover
New Century
New Century Adjustable
New Era
Pet
Semaphore with disappearing blade
Spring Ground Throw
Yard Stands

Tie Plates
Tie Rods
Track Bolts
Track Fastenings
Track Girders
Track Material of All Kinds
Trough Floors
Trough Sections
Viaducts
"Z" Bars

INTERMEDIATE SEMAPHORE SWITCH STAND, MODEL 50 E



Involved Manard Crossings

Chasmar-Winchell Press New York and Pittsburgh